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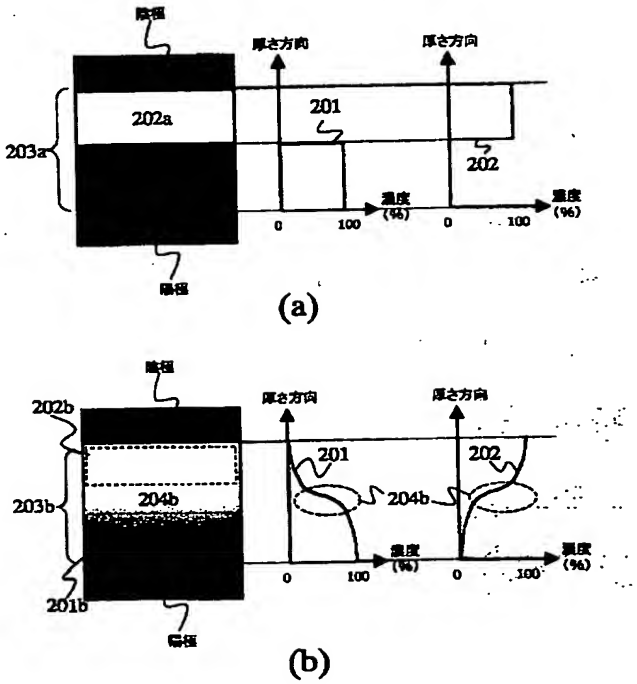
(54)【発明の名称】　発光装置およびその製造方法

(57)【要約】
【課題】　低消費電力で、寿命の長い発光装置および電気器具を提供する。
【解決手段】　有機化合物膜203b内に、第一の有機化合物201の濃度および第二の有機化合物202の濃度が徐々に変化している領域204bを設け、なおかつ、第一の有機化合物が機能を発現できる領域201bおよび第二の有機化合物が機能を発現できる領域202bは存在する構造を形成し、各材料の機能を発現する。この手法により、消費電力が低く寿命の長い有機発光素子を提供し、前記有機発光素子を用いて発光装置および電気器具を作製する。



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【特許請求の範囲】

【請求項１】陽極と、陰極と、前記陽極および前記陰極の間に挟まれた有機化合物膜と、を有する有機発光素子を含む発光装置において、前記有機化合物膜は、前記陽極から正孔を受け取る正孔注入性化合物、前記陰極から電子を受け取る電子注入性化合物、正孔輸送性化合物、電子輸送性化合物、正孔または電子の移動を阻止しうるブロッキング性化合物、発光を呈する発光性化合物、の一群から選ばれる少なくとも二つの化合物を含有し、かつ、前記二つの化合物のうち少なくとも一つは高分子化合物であることを特徴とする発光装置。

【請求項２】請求項１に記載の発光装置において、前記二つの化合物が混合している領域は、前記陽極および前記陰極から離れた位置に存在することを特徴とする発光装置。

【請求項３】請求項１または請求項２に記載の発光装置において、前記二つの化合物はホストであり、前記二つの化合物が混合している領域に、ゲストが添加されていることを特徴とする発光装置。

【請求項４】請求項３において、前記ゲストは、発光を呈する発光性化合物であることを特徴とする発光装置。

【請求項５】陽極と、陰極と、前記陽極および前記陰極の間に挟まれた有機化合物膜と、ヲ有する有機発光素子を含む発光装置において、前記有機化合物膜は、高分子化合物である第一の有機化合物と、前記第一の有機化合物とは異なる高分子化合物である第二の有機化合物と、を含有し、かつ、前記第一の有機化合物および前記第二の有機化合物が混合している混合領域を有することを特徴とする発光装置。

【請求項６】陽極と、陰極と、前記陽極および前記陰極の間に挟まれた有機化合物膜と、を有する有機発光素子を含む発光装置において、前記有機化合物膜は、高分子化合物である第一の有機化合物と、真空蒸着可能な低分子化合物である第二の有機化合物と、を含有し、かつ、前記第一の有機化合物および前記第二の有機化合物が混合している混合領域を有することを特徴とする発光装置。

【請求項７】請求項５に記載の発光装置において、前記第一の有機化合物の濃度および前記第二の有機化合物の濃度が、前記混合領域内において連続的に変化していることを特徴とする発光装置。

【請求項８】請求項６に記載の発光装置において、前記第一の有機化合物の濃度および前記第二の有機化合物の濃度が、前記混合領域内において連続的に変化していることを特徴とする発光装置。

【請求項９】請求項５または請求項７に記載の発光装置において、前記第一の有機化合物は正孔輸送性であり、かつ、前記第二の有機化合物は発光を呈する発光性であり、前記混合領域は前記陽極および前記陰極から離れた位置に存在することを特徴とする発光装置。

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【請求項１０】請求項５または請求項７に記載の発光装置において、前記第一の有機化合物は電子輸送性であり、かつ、前記第二の有機化合物は発光を呈する発光性であり、前記混合領域は前記陽極および前記陰極から離れた位置に存在することを特徴とする発光装置。

【請求項１１】請求項６または請求項８に記載の発光装置において、前記第一の有機化合物は正孔輸送性であり、かつ、前記第二の有機化合物は発光を呈する発光性であり、前記混合領域は前記陽極および前記陰極から離れた位置に存在することを特徴とする発光装置。

【請求項１２】請求項６または請求項８に記載の発光装置において、前記第一の有機化合物は電子輸送性であり、かつ、前記第二の有機化合物は発光を呈する発光性であり、前記混合領域は前記陽極および前記陰極から離れた位置に存在することを特徴とする発光装置。

【請求項１３】請求項６または請求項８に記載の発光装置において、前記第一の有機化合物は発光を呈する発光性であり、かつ、前記第二の有機化合物は正孔輸送性であり、前記混合領域は前記陽極および前記陰極から離れた位置に存在することを特徴とする発光装置。

【請求項１４】請求項６または請求項８に記載の発光装置において、前記第一の有機化合物は発光を呈する発光性であり、かつ、前記第二の有機化合物は電子輸送性であり、前記混合領域は前記陽極および前記陰極から離れた位置に存在することを特徴とする発光装置。

【請求項１５】請求項９乃至請求項１２に記載の発光装置において、前記第一の有機化合物は、π電子を含む高分子化合物であり、かつ、化学ドーピングを施されていることを特徴とする発光装置。

【請求項１６】請求項９または請求項１１に記載の発光装置において、前記第一の有機化合物は、ポリチオフェン誘導体、またはポリアニリン誘導体、またはポリビニルカルバゾール誘導体であることを特徴とする発光装置。

【請求項１７】請求項９または請求項１０に記載の発光装置において、前記第二の有機化合物は、ポリパラフェニレンビニレン誘導体、またはポリジアルキルフルオレン誘導体、またはポリビニルカルバゾール誘導体、またはポリフェニレン誘導体であることを特徴とする発光装置。

【請求項１８】請求項１３または請求項１４に記載の発光装置において、前記第二の有機化合物は、ポリパラフェニレンビニレン誘導体、またはポリジアルキルフルオレン誘導体、またはポリビニルカルバゾール誘導体、またはポリフェニレン誘導体であることを特徴とする発光装置。

【請求項１９】請求項５乃至請求項１８に記載の発光装置において、前記有機化合物膜は、前記第一の有機化合物および前記第二の有機化合物とは異なる第三の有機化合物を含有し、かつ、前記第三の有機化合物が、前記第

一の有機化合物および前記第二の有機化合物の両方を含む領域にゲストとして添加されていることを特徴とする発光装置。

【請求項２０】請求項１９に記載の発光装置において、前記第一の有機化合物および前記第二の有機化合物は、前記陽極から正孔を受け取る正孔注入性化合物、前記陰極から電子を受け取る電子注入性化合物、正孔輸送性化合物、電子輸送性化合物、正孔または電子の移動を阻止しうるブロッキング性化合物、の一群から選ばれる化合物であり、かつ、前記第三の有機化合物は、発光を呈する発光性化合物であることを特徴とする発光装置。

【請求項２１】請求項１９ないしは請求項２０に記載の発光装置において、前記第三の有機化合物は、三重項励起状態からの発光を呈する発光性化合物であることを特徴とする発光装置。

【請求項２２】請求項２１に記載の発光装置において、前記第三の有機化合物は、白金を中心金属とする金属錯体、またはイリジウムを中心金属とする金属錯体であることを特徴とする発光装置。

【請求項２３】請求項１９に記載の発光装置において、前記第三の有機化合物は、前記第一の有機化合物および前記第二の有機化合物に比べて、最高被占分子軌道と最低空分子軌道とのエネルギー差が大きいことを特徴とする発光装置。

【請求項２４】請求項１９に記載の発光装置において、前記第三の有機化合物は、フェナントロリン誘導体、またはオキサジアゾール誘導体、またはトリアゾール誘導体であることを特徴とする発光装置。

【請求項２５】請求項７または請求項８に記載の発光装置において、前記第一の有機化合物または前記第二の有機化合物を構成する元素のうち、SIMSにより検知できる前記元素の検出量が、前記陽極から前記陰極への方向に対して、連続的に変化する領域を有することを特徴とする発光装置。

【請求項２６】請求項７または請求項８に記載の発光装置において、前記有機化合物膜は、第１５族元素乃至第１７族元素を含み、SIMSにより検知できる前記第１５族元素乃至第１７族元素の検出量が、前記陽極から前記陰極への方向に対して、連続的に変化する領域を有することを特徴とする発光装置。

【請求項２７】請求項２６に記載の発光装置において、前記第１５族元素乃至第１７族元素が、窒素、燐、酸素、硫黄、弗素、塩素、臭素、沃素のいずれかであることを特徴とする発光装置。

【請求項２８】請求項１９または請求項２０に記載の発光装置において、前記第三の有機化合物は金属元素を有する金属錯体であり、SIMSにより検知できる前記金属元素の検出領域は、前記第一の有機化合物および前記第二の有機化合物の両方を含む領域であることを特徴とする発光装置。

【請求項２９】請求項２８に記載の発光装置において、前記金属元素は、アルミニウム、または亜鉛、またはベリリウムであることを特徴とする発光装置。

【請求項３０】請求項２８に記載の発光装置において、前記金属元素は、イリジウムまたは白金であることを特徴とする発光装置。

【請求項３１】電極を有する基板に対し、第１の有機化合物および第１の溶媒で構成される第１の溶液を湿式塗布し、前記第１の溶液を、前記第１の溶媒の蒸気圧が作業雰囲気の圧力以下になる温度にて加熱し、その後第２の有機化合物および第２の溶媒で構成される第２の溶液を塗布することを特徴とする、有機発光素子を含む発光装置の製造方法。

【請求項３２】電極を有する基板に対し、第１の有機化合物および第１の溶媒で構成される第１の溶液を湿式塗布して加熱乾燥した後、前記第１の溶液に含まれる溶媒が作業雰囲気に含まれる状態にて、次いで第２の有機化合物および第２の溶媒で構成される第２の溶液を塗布することを特徴とする、有機発光素子を含む発光装置の製造方法。

【請求項３３】電極を有する基板に対し、第１の有機化合物を成膜した後、第２の有機化合物および第２の溶媒で構成される第２の溶液を湿式塗布する際に、前記第２の溶媒に対する溶解度は、前記第１の有機化合物よりも前記第２の有機化合物の方が高いことを特徴とする、有機発光素子を含む発光装置の製造方法。

【請求項３４】電極を有する基板に対し、第１の有機化合物を成膜した後、前記第１の有機化合物を溶解できる溶媒が作業雰囲気に含まれる状態にて、次いで第２の有機化合物および第２の溶媒で構成される第２の溶液を湿式塗布することを特徴とする、有機発光素子を含む発光装置の製造方法。

【請求項３５】電極を有する基板に対し、第１の有機化合物を溶解した第１の溶液を湿式塗布した後、真空槽内において、次いで第２の有機化合物を真空蒸着により成膜し、その後加熱乾燥することを特徴とする、有機発光素子を含む発光装置の製造方法。

【請求項３６】請求項３５に記載の製造方法において、前記加熱乾燥は、10^{-4}パスカル以下の減圧下にて実施することを特徴とする、有機発光素子を含む発光装置の製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する分野】本発明は、陽極と、陰極と、電界を加えることで発光が得られる有機化合物を含む膜（以下、「有機化合物膜」と記す）と、を有する有機発光素子を用いた発光装置に関する。本発明では特に、有機化合物膜が高分子化合物を含み、従来よりも駆動電圧が低く、なおかつ素子の寿命が長い有機発光素子を用いた発光装置、およびその製造方法に関する。なお、本明細書

中における発光装置とは、発光素子として有機発光素子を用いた画像表示デバイスもしくは発光デバイスを指す。また、有機発光素子にコネクター、例えば異方導電性フィルム（FPC：Flexible printed circuit）もしくはTAB（Tape Automated Bonding）テープもしくはTCP（Tape Carrier Package）が取り付けられたモジュール、TABテープやTCPの先にプリント配線板が設けられたモジュール、または有機発光素子にCOG（Chip OnGlass）方式によりIC（集積回路）が直接実装されたモジュールも全て発光装置に含むものとする。

【０００２】

【従来の技術】有機発光素子は、電界を加えることにより発光する素子である。その発光機構は、電極間に有機化合物膜を挟んで電圧を印加することにより、陰極から注入された電子および陽極から注入された正孔が有機化合物膜中の発光中心で再結合して励起状態の分子（以下、「分子励起子」と記す）を形成し、その分子励起子が基底状態に戻る際にエネルギーを放出して発光すると言われている。

【０００３】なお、有機化合物が形成する分子励起子の種類としては、一重項励起状態と三重項励起状態が可能であるが、本明細書中ではどちらの励起状態が発光に寄与する場合も含むこととする。

【０００４】このような有機発光素子において、通常、有機化合物膜は1μmを下回るほどの薄膜で形成される。また、有機発光素子は、有機化合物膜そのものが光を放出する自発光型の素子であるため、従来の液晶ディスプレイに用いられているようなバックライトも必要ない。したがって、有機発光素子は極めて薄型軽量に作製できることが大きな利点である。

【０００５】また、例えば100～200nm程度の有機化合物膜において、キャリアを注入してから再結合に至るまでの時間は、有機化合物膜のキャリア移動度を考えると数十ナノ秒程度であり、キャリアの再結合から発光までの過程を含めてもマイクロ秒以内のオーダーで発光に至る。したがって、非常に応答速度が速いことも特長の一つである。

【０００６】さらに、有機発光素子はキャリア注入型の発光素子であるため、直流電圧での駆動が可能であり、ノイズが生じにくい。駆動電圧に関しては、まず有機化合物膜の厚みを100nm程度の均一な超薄膜とし、また、有機化合物膜に対するキャリア注入障壁を小さくするような電極材料を選択し、さらにはヘテロ構造（二層構造）を導入することによって、5.5Vで100cd/m^2の十分な輝度が達成された（文献１：C. W. Tang and S. A. Van Slyke, "Organic electroluminescent diodes", Applied Physics Letters, vol. 51, No.12, 913-915 (1987)）。

【０００７】こういった薄型軽量・高速応答性・直流低電圧駆動などの特性から、有機発光素子は次世代のフラットパネルディスプレイ素子として注目されている。また、自発光型であり視野角が広いことから、視認性も比較的良好であり、携帯機器の表示画面に用いる素子として有効と考えられている。

【０００８】ところで、文献１において示された有機発光素子の構成であるが、まず、キャリア注入障壁を小さくする方法として、仕事関数が低い上に比較的安定なMg:Ag合金を陰極に用い、電子の注入性を高めている。このことにより、有機化合物膜に大量のキャリアを注入することを可能としている。

【０００９】さらに有機化合物膜として、ジアミン化合物からなる正孔輸送層とトリス（８－キノリノラト）アルミニウム（以下、「Alq_3」と記す）からなる電子輸送性発光層とを積層するという、シングルヘテロ構造を適用することにより、キャリアの再結合効率を飛躍的に向上させている。このことは、以下のように説明される。

【００１０】例えば、Alq_3単層のみを有する有機発光素子の場合では、Alq_3が電子輸送性であるため、陰極から注入された電子のほとんどは正孔と再結合せずに陽極に達してしまい、発光の効率は極めて悪い。すなわち、単層の有機発光素子を効率よく発光させる（あるいは低電圧で駆動する）ためには、電子および正孔の両方をバランスよく輸送できる材料（以下、「バイポーラー材料」と記す）を用いる必要があり、Alq_3はその条件を満たしていない。

【００１１】しかし、文献１のようなシングルヘテロ構造を適用すれば、陰極から注入された電子は正孔輸送層と電子輸送性発光層との界面でブロックされ、電子輸送性発光層中へ閉じこめられる。したがって、キャリアの再結合が効率よく電子輸送性発光層で行われ、効率のよい発光に至るのである。

【００１２】このようなキャリアのブロッキング機能の概念を発展させると、キャリアの再結合領域を制御することも可能となる。その例として、正孔をブロックできる層（正孔ブロッキング層）を正孔輸送層と電子輸送層との間に挿入することにより、正孔を正孔輸送層内に閉じこめ、正孔輸送層の方を発光させることに成功した報告がある。（文献２：Yasunori KIJIMA, Nobutoshi ASAI and Shin-ichiro TAMURA, "A Blue Organic Light Emitting Diode", Japanese Journal of AppliedPhysics, Vol. 38, 5274-5277(1999)）。

【００１３】また、文献１における有機発光素子は、いわば正孔の輸送は正孔輸送層が行い、電子の輸送および発光は電子輸送性発光層が行うという、機能分離の発想であるとも言える。この機能分離の概念はさらに、正孔輸送層と電子輸送層の間に発光層を挟むというダブルヘテロ構造（三層構造）の構想へと発展した（文献３：Chihaya ADACHI, Shizuo TOKITO, Tetsuo TSUTSUI and Shogo SAITO, "Electroluminescence in Organic Films with Three-Layered Structure", Japanese Journal of

Applied Physics, Vol. 27, No. 2, L269-L271(1988))。

【００１４】こういった機能分離の利点としては、機能分離することによって一種類の有機材料に様々な機能（発光性、キャリア輸送性、電極からのキャリア注入性など）を同時に持たせる必要がなくなり、分子設計等に幅広い自由度を持たせることができる点にある（例えば、無理にバイポーラー材料を探索する必要がなくなる）。つまり、発光特性のいい材料、キャリア輸送性が優れる材料などを、各々組み合わせることで、容易に高発光効率が達成できるということである。

【００１５】これらの利点から、文献１で述べられた積層構造の概念（キャリアブロッキング機能あるいは機能分離）自体は、現在に至るまで広く利用されている。

【００１６】

【発明が解決しようとする課題】しかしながら、以上で述べたような積層構造は異種物質間の接合であるため、その界面には必ずエネルギー障壁が生じることになる。エネルギー障壁が存在すれば、その界面においてキャリアの移動は妨げられるため、以下に述べるような二つの問題点が提起される。

【００１７】まず一つは、駆動電圧のさらなる低減へ向けての障害になるという点である。実際、現在の有機発光素子において、駆動電圧に関しては共役ポリマーを用いた単層構造の素子の方が優れており、パワー効率（単位：[lm/W]）でのトップデータ（ただし、一重項励起状態からの発光を比較）を保持していると報告されている（文献４：筒井哲夫、「応用物理学会有機分子・バイオエレクトロニクス分科会会誌」、Vol. 11、No. 1、P.8（2000））。

【００１８】なお、文献４で述べられている共役ポリマーはバイポーラー材料であり、キャリアの再結合効率に関しては積層構造と同等なレベルが達成できる。したがって、バイポーラー材料を用いるなどの方法で、積層構造を用いることなくキャリアの再結合効率さえ同等にできるのであれば、界面の少ない単層構造の方が実際は駆動電圧が低くなることを示している。

【００１９】例えば電極との界面においては、エネルギー障壁を緩和するような材料を挿入し、キャリアの注入性を高めて駆動電圧を低減する方法がある（文献５：TakeoWakimoto, Yoshinori Fukuda, Kenichi Nagayama, Akira Yokoi, Hitoshi Nakada, and Masami Tsuchida, "Organic EL Cells Using Alkaline Metal Compoundsas Electron Injection Materials", IEEE TRANSACTIONS ON ELECTRON DEVICES, VOL. 44, NO. 8, 1245-1248(1997))。文献５では、電子注入層としてLi_2Oを用いることにより、駆動電圧の低減に成功している。

【００２０】しかしながら、有機材料間（例えば正孔輸送層と発光層との間のことであり、以下、「有機界面」と記す）のキャリア移動性に関してはいまだ未解決の分野であり、単層構造の低駆動電圧に追いつくための重要なポイントであると考えられる。

【００２１】さらに、エネルギー障壁に起因するもう一つの問題点として、有機発光素子の素子寿命に対する影響が考えられる。すなわち、キャリアの移動が妨げられ、チャージが蓄積することによる輝度の低下である。

【００２２】この劣化機構に関してははっきりした理論は確立されていないが、陽極と正孔輸送層との間に正孔注入層を挿入し、さらにdc駆動ではなく矩形波のac駆動にすることによって、輝度の低下を抑えることができるという報告がある（文献６：S. A. VanSlyke, C. H. Chen, and C. W. Tang, "Organic electroluminescentdevices with improved stability", Applied Physics Letters, Vol. 69, No.15, 2160-2162(1996))。このことは、正孔注入層の挿入およびac駆動によって、チャージの蓄積を排除することにより、輝度の低下を抑えることができたという実験的な裏付けと言える。

【００２３】以上のことから、積層構造は容易にキャリアの再結合効率を高めることができ、なおかつ機能分離の観点から材料の選択幅を広くできるというメリットを持つ一方で、有機界面を多数作り出すことによってキャリアの移動を妨げ、駆動電圧や輝度の低下に影響を及ぼしていると言える。

【００２４】そこで本発明では、従来用いられている積層構造とは異なる概念の素子を作製することにより、有機化合物膜中に存在するエネルギー障壁を緩和してキャリアの移動性を高めると同時に、なおかつ積層構造の機能分離と同様に各種複数の材料の機能を発現させる（以下、「機能発現」と記す）ことを課題とする。それにより、従来よりも駆動電圧が低い上に素子の寿命が長い有機発光素子を提供することを課題とする。

【００２５】また、このような有機発光素子を用いることにより、従来よりも駆動電圧が低く、なおかつ寿命の長い発光装置を提供することを課題とする。さらに、前記発光装置を用いて電気器具を作製することにより、従来よりも低消費電力で、なおかつ長保ちする電気器具を提供することを課題とする。

【００２６】

【課題を解決するための手段】積層構造におけるエネルギー障壁の緩和に関しては、文献５に見られるようなキャリア注入層の挿入という技術に顕著に見られる。正孔注入層を例として、エネルギーバンドダイアグラムを用いた説明を図１に示す。

【００２７】図１(a)では陽極101と正孔輸送層102を直接接合しているが、この場合、陽極101と正孔輸送層102のエネルギー障壁104は大きい。しかしながら、陽極のイオン化ポテンシャルと正孔輸送層の最高被占分子軌道（以下、「HOMO」と記す）準位との中間に位置するHOMO準位を有する材料を、正孔注入層103として挿入することにより、エネルギー障壁を階段状に設計することがで

きる（図１(b)）。

【００２８】図１(b)のような階段状のエネルギー障壁を設計することにより、電極からのキャリア注入性を高め、確かに駆動電圧をある程度までは下げることができる。しかしながら問題点は、層の数を増やすことによって、有機界面の数は逆に増加することである。このことが、文献４で示されているように、単層構造の方が駆動電圧・パワー効率のトップデータを保持している原因であると考えられる。

【００２９】逆に言えば、この点を克服することにより、積層構造のメリット（様々な材料を組み合わせることができ、複雑な分子設計が必要ない）を活かしつつ、なおかつ単層構造の駆動電圧・パワー効率に追いつくことができる。

【００３０】そこで本発明者は、２種類以上（そのうち１種類以上は高分子化合物）の有機化合物を含む有機化合物膜において、実質上有機化合物膜中の界面をなくし、有機化合物膜中のエネルギー障壁を緩和する手法を考案した。

【００３１】すなわち、有機化合物膜が、前記陽極から正孔を受け取る正孔注入性化合物、前記陰極から電子を受け取る電子注入性化合物、正孔輸送性化合物、電子輸送性化合物、正孔または電子の移動を阻止しうるブロッキング性化合物、発光を呈する発光性化合物、の一群から選ばれる少なくとも二つの化合物を含有する場合、その少なくとも二つの化合物が混合している領域（以下、「混合領域」と記す）を設けることにより、実質上有機化合物膜中の界面をなくす手法である。以下ではこの手法を、混合接合と記す。

【００３２】なお、本発明において高分子化合物を用いる理由は、高分子化合物の方が一般的にキャリア移動度が大きく、低い電圧で駆動できるためである。つまり、高分子化合物を用いた系において、混合接合を実施することが本発明の特徴となる。

【００３３】この場合、正孔注入性化合物、電子注入性化合物、正孔輸送性化合物、電子輸送性化合物は、発光を呈する機能を兼ね備えていてもよい。また、発光性化合物は、キャリア輸送性・キャリア注入性を兼ね備えていてもよいし、キャリア輸送性の乏しい材料であってもよい。

【００３４】また、混合領域は陽極および陰極から離れた位置に形成することが好ましい。一つの理由として、キャリア注入、キャリア輸送、発光などの各機能を発現できる領域は保持したまま、有機化合物膜中の界面を混合領域とすることで、障壁を緩和させるためである。

【００３５】特に、混合領域が発光の機能を有する場合、混合領域を電極から遠ざけ、電極による消光（以下、「クエンチ」と記す）を防止するため、電極から離す必要がある。その場合、分子励起子の拡散を考慮し、混合領域を電極から20nm以上は離すことが好ましい。離す距離の程度は、キャリアバランスを考慮して最も効率の良い距離を選択すればよい。

【００３６】ところで、このような混合接合を形成する場合において、混合領域に対してゲストをドープする手法も考えられる。混合領域においては、キャリアの移動が潤滑であると考えられるため、ゲストとして発光を呈する発光性化合物を用いることが好ましい。

【００３７】以上で述べたような混合接合を実施することにより、明瞭な積層構造を示すことなく（すなわち、明確な有機界面がなく）、かつ、機能発現が可能な有機発光素子を作製できる。

【００３８】また、第一の有機化合物と、前記第一の有機化合物とは異なる第二の有機化合物と、を含有している有機化合物膜中において、前記第一の有機化合物および前記第二の有機化合物が混合している混合領域を設ける場合、第一の有機化合物および第二の有機化合物が共に高分子化合物である場合と、一方が低分子化合物である場合がある。さらに、混合領域において連続的な濃度変化を付与する手法が、なお好ましい。以下ではこれらの手法を、「連続接合」と記すことにする。また、その場合の混合領域を特に、「連続接合領域」と記す。

【００３９】従来の積層構造および本発明の連続接合の概念図を図２に示す。図２(a)は従来の積層構造（シングルヘテロ構造）である。すなわち、第一の有機化合物201および第二の有機化合物202からなる有機化合物膜203aを有し、かつ、第一の有機化合物層201aおよび第二の有機化合物層202aから形成される積層構造（あるいは、明確な有機界面と言ってもよい）が存在している。この場合、第一の有機化合物201の濃度および第二の有機化合物202の濃度が徐々に変化する領域は存在せず、不連続になっていることがわかる（すなわち、有機界面において、濃度が０％から１００％に変化、あるいは１００％から０％に変化している）。

【００４０】しかしながら本発明の連続接合（図２(b)）の場合、有機化合物膜203b内に、第一の有機化合物201の濃度および第二の有機化合物202の濃度が徐々に変化している領域（すなわち連続接合領域204b）が存在するため、明確な有機界面は存在しない。しかしながら、第一の有機化合物が機能を発現できる領域（第一機能領域201b）および第二の有機化合物が機能を発現できる領域（第二機能領域202b）は存在するため、各材料の機能は発現できる。

【００４１】以上で述べたような連続接合を実施することにより、明瞭な積層構造を示すことなく（すなわち、明確な有機界面がなく）、かつ、機能発現が可能な有機発光素子を作製できる。

【００４２】ところで、第一の有機化合物および第二の有機化合物は、本発明の概念（すなわち、積層構造を用いずに、各種複数の材料の機能を発現する）の観点から、異なる機能を有することが好ましい。

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【００４３】この場合、第一の有機化合物および第二の有機化合物が共に高分子化合物であれば、一方が発光を呈し、もう一方がキャリア輸送機能を発現する構成が考えられる。また、第二の有機化合物が低分子化合物である場合には、低分子化合物が発光を呈し、高分子化合物がキャリア輸送機能を発現する構成と、高分子化合物が発光を呈し、低分子化合物がキャリア輸送機能を発現する構成が考えられる。

【００４４】さらに、高分子化合物がキャリア輸送機能を発現する場合、前記高分子化合物がπ電子を含む高分子化合物（すなわち、導電性高分子化合物）であり、さらに前記高分子化合物に化学ドーピングを施すことにより、導電性を向上させることが好ましい。

【００４５】なお、正孔輸送性化合物として用いる高分子化合物としては、ポリチオフェン誘導体、ポリアニリン誘導体、ポリビニルカルバゾール誘導体などが好ましく、また、発光性化合物として用いる高分子化合物としては、ポリフェニレン誘導体、ポリパラフェニレンビニレン誘導体、ポリジアルキルフルオレン誘導体などが好ましい。

【００４６】また、以上で述べたような混合接合（連続接合を含む）を実施する際、混合領域において、第三の有機化合物をゲストとして添加することで、前記ゲストの機能を付与する手法が考えられる。機能発現の観点からは、発光を呈する発光性化合物をゲストとすることが好ましい。なぜならば、混合領域を形成する第一の有機化合物および第二の有機化合物にはキャリアの輸送性ないしはブロッキング性を持たせ、その混合領域に発光性化合物を添加することで、キャリアの再結合率を高め、発光効率が高くなると考えられるためである。

【００４７】その概念図を図３(a)に示す。図３(a)では、基板301上において、陽極302と陰極304との間に、第一の有機化合物および第二の有機化合物を含む有機化合物膜303を設け、その混合領域305に発光を呈する化合物306を添加して、発光領域とした。

【００４８】ところで近年、発光効率の観点で言えば、三重項励起状態から基底状態に戻る際に放出されるエネルギー（以下、「三重項励起エネルギー」と記す）を発光に変換できる有機発光素子が、その高い発光効率ゆえに注目されている（文献７：D. F. O'Brien, M. A. Baldo, M. E. Thompson and S. R. Forrest, "Improvedenergy transfer in electrophosphorescent devices", Applied Physics Letters, vol. 74, No. 3, 442-444 (1999)）（文献８：Tetsuo TSUTSUI, Moon-Jae YANG, Masayuki YAHIRO, Kenji NAKAMURA, Teruichi WATANABE, Taishi TSUJI, Yoshinori FUKUDA, Takeo WAKIMOTO and Satoshi MIYAGUCHI, "High Quantum Efficiency in Organic Light-Emitting Devices with Iridium-Complex as a Triplet Emissive Center", Japanese Journal of Applied Physics, Vol. 38, L1502-L1504 (1999)）。

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【００４９】文献７では白金を中心金属とする金属錯体を、文献８ではイリジウムを中心金属とする金属錯体を用いている。これらの三重項励起エネルギーを発光に変換できる有機発光素子（以下、「三重項発光素子」と記す）は、従来よりも高輝度発光・高発光効率を達成することができる。

【００５０】しかしながら、文献８の報告例によると、初期輝度を500cd/m^{2}に設定した場合の輝度の半減期は170時間程度であり、素子寿命に問題がある。そこで、本発明を三重項発光素子に適用することにより、三重項励起状態からの発光による高輝度発光・高発光効率に加え、素子の寿命も長いという非常に高機能な発光素子が可能となる。

【００５１】したがって、ゲストである第三の有機化合物として、三重項励起エネルギーを発光に変換できる材料を選択し、混合領域に添加した場合も本発明に含めることとする。

【００５２】第三の有機化合物として考えられるものは、発光を呈する発光性化合物に限る必要はない。特に、第一の有機化合物ないしは第二の有機化合物が発光を呈する場合には、第三の有機化合物として、前記第一の有機化合物および前記第二の有機化合物に比べて、最高被占分子軌道（HOMO）と最低空分子軌道（LUMO）とのエネルギー差が大きい化合物（すなわち、キャリアおよび分子励起子をブロッキングできる化合物）を用いることが好ましい。この手法により、第一の有機化合物および第二の有機化合物により形成された混合領域において、キャリアの再結合率を高め、発光効率を高めることが可能となる。

【００５３】その概念図を図３(b)に示す。図３(b)では、基板301上において、陽極302と陰極304との間に、第一の有機化合物および第二の有機化合物を含む有機化合物膜303を設け、その濃度変化領域305にキャリアおよび分子励起子をブロッキングできる化合物（ブロッキング性化合物）307を添加した。

【００５４】なお、図３(b)では、混合領域305に対し、さらに発光を呈する発光性化合物306を添加した発光領域も設けてある。すなわち、第三の有機化合物として発光を呈する発光性化合物を用いる手法（図３(a)）と、ブロッキング性化合物の添加とを併合した形態である。ここでは、キャリアおよび分子励起子をブロッキングできる化合物307の方が発光を呈する発光性化合物306よりも陰極側にあるため、キャリアおよび分子励起子をブロッキングできる化合物307は正孔ブロッキング性のものを用いればよい。

【００５５】キャリアおよび分子励起子をブロッキングできる化合物としては、フェナントロリン誘導体、オキサジアゾール誘導体、トリアゾール誘導体などが考えられる。

【００５６】ところで、以上で述べたような混合領域を

特定する場合に、SIMSによる元素分析が重要な技術になると考えられる。特に、連続接合の場合は、図２で示した概念図からもわかるように、従来の積層構造と比べて顕著な差が現れると考えられる。

【００５７】したがって、第一の有機化合物または第二の有機化合物を構成する元素のうち、SIMSにより検知できる前記元素の検出量が、前記陽極から前記陰極への方向に対して、連続的に変化する領域を有する発光装置を、本発明に含めるものとする。

【００５８】また、第１５族元素ないしは第１６族元素を含む高分子化合物は一般に有機発光素子によく用いられ、また、高分子化合物の導電性を向上させるために第１７族元素を含む化合物が化学ドーピングされることがある。そこで、第１５族元素乃至第１７族元素を含む材料と、含まない材料と、から連続接合領域を形成することにより、より顕著に濃度変化を観察することができる。第１５族元素乃至第１７族元素としては、窒素、燐、酸素、硫黄、弗素、塩素、臭素、沃素などが主流である。

【００５９】さらに、混合領域に対して第三の有機化合物をゲストとして添加する場合、そのゲストとなる化合物、特に発光を呈する発光性化合物として、金属錯体が用いられることがある。

【００６０】したがって、第三の有機化合物は金属元素を有する金属錯体であり、SIMSにより検知できる前記金属元素の検出領域は、前記第一の有機化合物および前記第二の有機化合物の両方を含む領域（すなわち混合領域）である発光装置も、本発明に含めるものとする。金属元素としては、アルミニウム、または亜鉛、またはベリリウムが主流である。また、第三の有機化合物が三重項励起状態からの発光を呈する発光性化合物である場合、イリジウムや白金を中心金属とする金属錯体が主流であるため、イリジウムや白金を検出できる。

【００６１】以上のような本発明を実施することにより、従来よりも駆動電圧が低く、なおかつ寿命の長い発光装置を提供することができる。さらに、前記発光装置を用いて電気器具を作製することにより、従来よりも低消費電力で、なおかつ長保ちする電気器具を提供することができる。

【００６２】

【発明の実施の形態】以下では、本発明を実施する際の形態について述べる。なお、有機発光素子は、発光を取り出すために少なくとも陽極または陰極の一方が透明であればよいが、本実施の形態では、基板上に透明な陽極を形成し、陽極から光を取り出す素子構造で記述する。実際は、陰極から光を取り出す構造や、基板とは逆側から光を取り出す構造も本発明に適用可能である。

【００６３】本発明を実施するに当たり、混合領域ないしは連続接合領域を形成する製造工程が重要になる。本発明者は、高分子化合物を含む有機化合物膜において、混合領域ないしは連続接合領域を形成する工程を考案した。そこで、ここでは本発明で開示した有機発光素子の製造方法について述べる。

【００６４】従来の工程（湿式塗布にて積層構造を構成する場合）では、例えば第一の有機化合物が溶解した第一の溶液を塗布し、加熱等により前記第一の溶液に含まれる溶媒を完全に除去した後に、第一の有機化合物が溶出しない溶液に溶解した第二の有機化合物を成膜するため、明確な有機界面を生じることになる。

【００６５】例えば、ポリスチレンスルホン酸（以下、「PSS」と記す）をドープしたポリエチレンジオキシチオフェン（以下、「PEDOT」と記す）の水溶液をスピンコーティングにより成膜し、大気圧下において100℃以上で加熱処理して水を完全に除去した後、アルコキシル基を有するポリパラフェニレンビニレン（以下、「PPV」と記す）のトルエン溶液をスピンコーティングにより成膜して再び加熱乾燥した有機化合物膜の、断面TEM写真を図４に示す。図４から明らかであるように、従来の工程では、明確な有機界面を生じる積層構造となる。

【００６６】このことを解決し、混合領域または濃度変化領域を形成する工程として、五つの製造方法を本発明者は考案した。以下ではその実施の形態について、最も簡単な例である、二種類の有機化合物を含む有機化合物膜の場合について記す。

【００６７】第一の製造方法を、図５に示す。まず、電極502を設けた基板501（図５(a)）上に、第一の有機化合物（高分子化合物）が溶解した第一の溶液503aを湿式塗布する（図５(b)）。次に、混合領域ないしは連続接合領域を形成する工程511として、第一の溶液に含まれる溶媒の蒸気圧が作業雰囲気の気圧以下になる温度にて加熱し（図５(c)）、第一の溶液に含まれる溶媒が残存した状態503bにて、第二の有機化合物が溶解した第二の溶液504を湿式塗布する（図５(d)）。最後に、加熱512により溶媒を全て除去し、混合領域ないしは連続接合領域505を有する本発明の有機化合物膜を得る。

【００６８】次に、第二の製造方法を図６に示す。まず、電極602を設けた基板601上に、第一の有機化合物（高分子化合物）が溶解した第一の溶液603aを湿式塗布する（図６(a)）。次に、加熱611により第一の溶液603aに含まれる溶媒を完全に除去することで、第一の有機化合物膜603bを形成する（図６(b)）。さらに、混合領域ないしは連続接合領域を形成する工程612として、第一の溶液に含まれる溶媒が作業雰囲気に含まれる状態に置くことで溶出領域603cを形成し（図６(c)）、その後第二の有機化合物が溶解した第二の溶液604を湿式塗布する（図６(d)）。最後に、加熱613により溶媒を全て除去し、混合領域ないしは連続接合領域605を有する本発明の有機化合物膜を得る。

【００６９】また、第三の製造方法として、第一の有機化合物として乾式成膜できる低分子化合物を用い、混合

領域ないしは連続接合領域を形成することができる。すなわち、真空蒸着法などにより第一の有機化合物膜603bを成膜した（つまり、図６(b)の状態）あと、第一の有機化合物をわずかに溶解できる溶媒に溶かした第二の有機化合物（高分子化合物）を湿式塗布し、図６(d)の状態を形成する手法である。

【００７０】さらに、第四の製造方法であるが、図６において、第一の有機化合物として低分子化合物を用いることもできる。すなわち、まず真空蒸着法などにより第一の有機化合物膜603bを成膜して図６(b)の状態を形成し、第一の有機化合物を溶解できる溶媒が作業雰囲気に含まれる状態に置くことで、溶出領域603cを形成する（図６(c)）手法である。

【００７１】ところで、上で述べた第一の製法～第四の製法は全て、第二の有機化合物が湿式塗布する高分子材料で構成されている。それとは逆に、第五の製造法として、先に第一の有機化合物として高分子材料を湿式塗布し、第二の有機化合物として低分子化合物を真空蒸着してから混合領域ないしは連続接合領域を形成する手法も、本発明者は考案した。

【００７２】その第五の手法は、電極を有する基板に対し、第一の有機化合物（高分子化合物）を溶解した溶液を湿式塗布した後、真空槽内に搬送し、次いで第二の有機化合物（低分子化合物）を真空蒸着により成膜し、その後加熱することにより第二の有機化合物（低分子化合物）を拡散させ、混合領域ないしは濃度変化領域を形成する手法である。加熱温度は、前記第一の有機化合物が溶解している溶媒が完全に除去できる温度であればよい。

【００７３】第五の手法において、加熱を10^{-4}パスカルの減圧下において行う手法は、さらに好ましい。この場合、加熱温度は60℃～100℃程度が好ましい。

【００７４】以上で述べたような湿式塗布法に関しては、様々な手法が可能であり、一般に用いられるスピンコーティング、ディップコーティング等の湿式成膜法の他、交互吸着法やインクジェット方式が考えられる。特にインクジェット方式は、有機化合物を高精度にパターニングすることが可能であり、また広い範囲に渡ってパターニングすることも可能であるため、高精細、大面積な発光装置を作成する際に有効な手法であると考えられている。

【００７５】前記第一の製造方法を、インクジェット方式により実現する概念図を図７に示す。まず、電極702を有する基板701（図７(a)）上に、フォトリソグラフィー技術により、土手構造706を形成する（図７(b)）。次に、第一の有機化合物（高分子化合物）が溶解した第一の溶液703aを、インクジェットプリンタヘッド721aにより湿式塗布する（図７(c)）。さらに、混合領域ないしは連続接合領域を形成する工程711として、第一の溶液703aに含まれる溶媒の蒸気圧が作業雰囲気の気圧になる温度よりも低い温度にて加熱し（図７(d)）、第一の溶液に含まれる溶媒が残存した状態703bにて、第二の有機化合物が溶解した第二の溶液704をインクジェットプリンタヘッド721bにより湿式塗布する（図７(e)）。最後に、加熱により溶媒を全て除去し、混合領域ないしは連続接合領域を有する本発明の有機化合物膜を得る。

【００７６】例えば、第二の有機化合物として発光を呈する化合物を用いる場合、赤、緑、青それぞれの色を呈する化合物を、インクジェットプリンタヘッド721bを用いて各画素707a～707cを塗り分けることによって、フルカラーの発光装置を作製することができる。

【００７７】以上で述べたような製造方法により、本発明で開示した混合領域または連続接合領域を形成することができる。

【００７８】

【実施例】［実施例１］本実施例では、発明の実施の形態において図５に示した手法を適用することにより作製する有機発光素子を、具体的に例示する。

【００７９】まず、ガラス基板上にインジウム錫酸化物（以下、「ITO」と記す）をスパッタリングによって100nm程度成膜し、陽極とする。次に、正孔輸送性の材料としてPSSをドープしたPEDOTの水溶液を、スピンコーティングによって前記陽極上に成膜する。

【００８０】ここで、図５で示したように、水の蒸気圧が大気圧になる温度（100℃）よりも低い温度にて前記基板を加熱し、PEDOT水溶液の水分がわずかに残存した状態とする。さらに、トルエンを溶媒とするアルコキシル基置換PPV（以下、「MEH－PPV」と記す）をスピンコーティングにより成膜し、100℃以上に加熱することにより溶媒を完全に除去する。

【００８１】最後に、陰極としてイッテルビウムを真空蒸着により400nm蒸着し、MEH－PPVに由来する緑色の発光を呈する本発明の有機発光素子を得る。

【００８２】［実施例２］本実施例では、発明の実施の形態において図６で示した手法を適用することにより作製する有機発光素子を、具体的に例示する。

【００８３】まず、ガラス基板601上にITOをスパッタリングによって100nm程度成膜し、陽極602とする。次に、正孔輸送性の材料としてPSSをドープしたPEDOTの水溶液を、スピンコーティングによって前記陽極上に成膜し、150℃で１０分間加熱することにより溶媒（水分）を完全に除去する。

【００８４】ここで、図６で示したように、水蒸気を含む雰囲気下において、キシレンを溶媒とするポリジオクチルフルオレン（以下、「PDOF」と記す）をスピンコーティングにより成膜し、その後100℃以上に加熱することにより、水およびキシレンを完全に除去する。

【００８５】最後に、陰極としてカルシウムを真空蒸着により100nm、次いでアルミニウムを150nm蒸着し、PDOFに由来する青色の発光を呈する本発明の有機発光素子を

得る。

【００８６】［実施例３］本実施例では、低分子化合物を真空蒸着により成膜したあと、その低分子化合物がわずかに溶解する溶媒に溶かした高分子化合物を塗布する手法を適用することにより作製する有機発光素子を、具体的に例示する。

【００８７】まず、ガラス基板上にインジウム錫酸化物（以下、「ITO」と記す）をスパッタリングによって100nm程度成膜し、陽極とする。次に、正孔輸送性の材料として、４，４'，４"－トリス［Ｎ－（３－メチルフェニル）－Ｎ－フェニル－アミノ］－トリフェニルアミン（以下、「MTDATA」と記す）を、前記陽極上に真空蒸着により成膜する。

【００８８】ここで、極性溶媒に可溶なPPV前駆体をエタノールに溶解した溶液を、スピンコーティングにより成膜する。その後80℃以上に加熱することにより、溶媒を完全に除去すると同時にPPVを重合させる。

【００８９】最後に、陰極としてイッテルビウムを真空蒸着により400nm蒸着し、PPVに由来する緑色の発光を呈する本発明の有機発光素子を得る。

【００９０】［実施例４］本実施例では、インクジェット方式の手法を適用することにより作製する有機発光素子を、具体的に例示する。

【００９１】まず、ガラス基板701上にITO702をスパッタリングによって100nm程度成膜し、さらにフォトリソグラフィー技術により土手構造706を形成する（図７(b)）。次に、正孔輸送性の材料としてPSSをドープしたPEDOTの水溶液703aをインクジェットプリンタヘッド721aによって前記陽極上に成膜し、150℃で１０分間加熱することにより溶媒（水分）を完全に除去する。このように成膜されたPEDOT703aは、水に溶けにくくなり、わずかに溶出する程度となる。

【００９２】ここでさらに、水溶性のPPV前駆体を溶解した水溶液704を用いたインクを、インクジェットプリンタヘッド721bにより成膜し、その後100℃以上に加熱することにより、水およびキシレンを完全に除去する。

【００９３】最後に、陰極としてカルシウムを真空蒸着により100nm、次いでアルミニウムを150nm蒸着し、PPVに由来する緑色の発光を呈する本発明の有機発光素子を得る。

【００９４】［実施例５］本実施例では、電極を有する基板に対し、第１の有機化合物（高分子化合物）を溶解した溶液を湿式塗布した後、真空槽内に搬送し、次いで第２の有機化合物（低分子化合物）を真空蒸着により成膜し、その後加熱することにより第２の有機化合物（低分子化合物）を拡散させ、混合領域ないしは連続接合領域を形成することにより、その混合領域ないしは連続接合領域に発光を呈する化合物（ここでは三重項励起状態からの発光を呈する化合物）がドープされた有機発光素子を作製する例を、具体的に例示する。この時、加熱温度は、前記第１の有機化合物が溶解している溶媒が完全に除去できる温度であればよい。更に、加熱を１０^{-4}パスカル程度の減圧下において行うと、より好ましい。

【００９５】まず、ガラス基板上にインジウム錫酸化物（以下、「ITO」と記す）をスパッタリングによって100nm程度成膜し、陽極とする。次に、正孔輸送性の材料として、ポリビニルカルバゾール（以下、「PVK」と記す）を用いるため、PVKのクロロホルム溶液をスピンコーティングにより成膜し、加熱により溶媒を除去する。このあと、同じ溶媒（クロロホルム）を用いた溶液をコーティングするので、この成膜は、ある程度膜厚を大きくするために数回行うことが望ましい。

【００９６】次に、PVKのクロロホルム溶液に、三重項発光材料であるビス（２－フェニルピリジン）－アセチルアセトナトイリジウム（以下、「$Ir(ppy)_2(acac)$」と記す）錯体を5wt%添加した溶液を用意し、先に成膜したPVK膜上にスピンコーティングで成膜する。

【００９７】ここで、基板を加熱することなく、電子輸送材料であるトリス（８－キノリノラト）アルミニウム（以下、「Alq_3」と記す）を１０^{-3}パスカルの減圧下において真空蒸着する。その後、１０^{-4}パスカルの減圧下において、80℃でベークすることにより、PVKおよびAlq_3をホストとして$Ir(ppy)_2(acac)$をゲストとした領域（PVKとAlq_3との混合領域に$Ir(ppy)_2(acac)$をドープした領域）を形成することができる。

【００９８】最後に、陰極としてAl:Li合金を真空蒸着により150nm蒸着し、$Ir(ppy)_2(acac)$に由来する緑色の発光を呈する本発明の有機発光素子を得る。

【００９９】［実施例６］本実施例では、本発明で開示した有機発光素子を含む発光装置について説明する。図８は本発明の有機発光素子を用いたアクティブマトリクス型発光装置の断面図である。なお、能動素子としてここでは薄膜トランジスタ（以下、「TFT」と記す）を用いているが、MOSトランジスタを用いてもよい。

【０１００】また、TFTとしてトップゲート型TFT（具体的にはプレーナ型TFT）を例示するが、ボトムゲート型TFT（典型的には逆スタガ型TFT）を用いることもできる。

【０１０１】図８において、801は基板であり、ここでは可視光を透過する基板を用いる。具体的には、ガラス基板、石英基板、結晶化ガラス基板もしくはプラスチック基板（プラスチックフィルムを含む）を用いればよい。なお、基板801とは、表面に設けた絶縁膜も含めるものとする。

【０１０２】基板801の上には画素部811および駆動回路812が設けられている。まず、画素部811について説明する。

【０１０３】画素部811は画像表示を行う領域である。基板上には複数の画素が存在し、各画素には有機発光素子に流れる電流を制御するためのTFT（以下、「電流制

御TFT」と記す）802、画素電極（陽極）803、有機化合物膜804および陰極805が設けられている。なお、図８では電流制御TFTしか図示していないが、電流制御TFTのゲートに加わる電圧を制御するためのTFT（以下、「スイッチングTFT」と記す）を設けている。

【０１０４】電流制御TFT802は、ここではpチャネル型TFTを用いることが好ましい。nチャネル型TFTとすることも可能であるが、図８のように有機発光素子の陽極に電流制御TFTを接続する場合は、pチャネル型TFTの方が消費電力を押さえることができる。ただし、スイッチングTFTはnチャネル型TFTでもpチャネル型TFTでもよい。

【０１０５】また、電流制御TFT802のドレインには画素電極803が電気的に接続されている。本実施例では、画素電極803の材料として仕事関数が4.5～5.5eVの導電性材料を用いるため、画素電極803は有機発光素子の陽極として機能する。画素電極803として代表的には、酸化インジウム、酸化錫、酸化亜鉛もしくはこれらの化合物（ITOなど）を用いればよい。画素電極803の上には有機化合物層804が設けられている。

【０１０６】さらに、有機化合物層804の上には陰極805が設けられている。陰極805の材料としては、仕事関数が2.5～3.5eVの導電性材料を用いることが望ましい。陰極805として代表的には、アルカリ金属元素もしくはアルカリ度類金属元素を含む導電膜、アルミニウムを含む導電膜、あるいはその導電膜にアルミニウムや銀などを積層したもの、を用いればよい。

【０１０７】また、画素電極803、有機化合物層804、および陰極805からなる層は、保護膜806で覆われている。保護膜806は、有機発光素子を酸素および水から保護するために設けられている。保護膜806の材料としては、窒化珪素、窒化酸化珪素、酸化アルミニウム、酸化タンタル、もしくは炭素（具体的にはダイヤモンドライクカーボン）を用いる。

【０１０８】次に、駆動回路812について説明する。駆動回路812は画素部811に伝送される信号（ゲート信号およびデータ信号）のタイミングを制御する領域であり、シフトレジスタ、バッファ、ラッチ、アナログスイッチ（トランスファゲート）もしくはレベルシフタが設けられている。図８では、これらの回路の基本単位としてnチャネル型TFT807およびpチャネル型TFT808からなるCMOS回路を示している。

【０１０９】なお、シフトレジスタ、バッファ、ラッチ、アナログスイッチ（トランスファゲート）もしくはレベルシフタの回路構成は、公知のものでよい。また図８では、同一の基板上に画素部811および駆動回路812を設けているが、駆動回路812を設けずにICやLSIを電気的に接続することもできる。

【０１１０】また、図８では電流制御TFT802に画素電極（陽極）803が電気的に接続されているが、陰極が電流制御TFTに接続された構造をとることもできる。その場合、画素電極を陰極805と同様の材料で形成し、陰極を画素電極（陽極）803と同様の材料で形成すればよい。その場合、電流制御TFTはnチャネル型TFTとすることが好ましい。

【０１１１】ところで、図８に示した発光装置は、画素電極803を形成した後に配線809を形成する工程で作製されたものを示してあるが、この場合、画素電極803が表面荒れを起こす可能性がある。有機発光素子は電流駆動型の素子であるため、画素電極803の表面荒れにより、特性が悪くなることも考えられる。

【０１１２】そこで、図９に示すように、配線909を形成した後に画素電極903を形成する発光装置も考えられる。この場合、図８の構造に比べて、画素電極903からの電流の注入性が向上すると考えられる。

【０１１３】また、図８および図９においては、正テーパー型の土手状構造810または910によって、画素部811または911に設置されている各画素を分離している。この土手状構造を、例えば逆テーパー型のような構造にすることにより、土手状構造が画素電極に接しない構造をとることもできる。その一例を図１０に示す。

【０１１４】図１０では、配線を利用して分離部を兼ねた、配線および分離部1010を設けた。図１０で示されるような配線および分離部1010の形状（ひさしのある構造）は、配線を構成する金属と、前記金属よりもエッチレートの低い材料（例えば金属窒化物）とを積層し、エッチングすることにより形成することができる。この形状により、画素電極1003や配線と、陰極1005とが、ショートすることを防ぐことができる。なお、図１０においては、通常のアクティブマトリクス型の発光装置と異なり、画素上の陰極1005をストライプ状（パッシブマトリクスの陰極と同様）にする構造になる。

【０１１５】ここで、図９に示したアクティブマトリクス型発光装置の外観を図１１に示す。なお、図１１(a)には上面図を示し、図１１(b)には図１１(a)をP－P'で切断した時の断面図を示す。また、図９の符号を引用する。

【０１１６】図１１(a)において、1101は画素部、1102はゲート信号側駆動回路、1103はデータ信号側駆動回路である。また、ゲート信号側駆動回路1102およびデータ信号側駆動回路1103に伝送される信号は、入力配線1104を介してTAB（Tape Automated Bonding）テープ1105から入力される。なお、図示しないが、TABテープ1105の代わりに、TABテープにIC（集積回路）を設けたTCP（Tape Carrier Package）を接続してもよい。

【０１１７】このとき、1106は図９に示した有機発光素子の上方に設けられるカバー材であり、樹脂からなるシール材1107により接着されている。カバー材1106は酸素および水を透過しない材質であれば、いかなるものを用いてもよい。本実施例では、カバー材1106は図１１(b)に示すように、プラスチック材1106aと、前記プラスチ

ック材1106aの表面および裏面に設けられた炭素膜（具体的にはダイヤモンドライクカーボン膜）1106b、1106cからなる。

【０１１８】さらに、図１１(b)に示すように、シール材1107は樹脂からなる封止材1108で覆われ、有機発光素子を完全に密閉空間1109に封入するようになっている。密閉空間1109は不活性ガス（代表的には窒素ガスや希ガス）、樹脂または不活性液体（例えばパーフルオロアルカンに代表される液状のフッ素化炭素）を充填しておけばよい。さらに、吸湿剤や脱酸素剤を設けることも有効である。

【０１１９】また、本実施例に示した発光装置の表示面（画像を観測する面）に偏光板をもうけてもよい。この偏光板は、外部から入射した光の反射を押さえ、観測者が表示面に映り込むことを防ぐ効果がある。一般的には、円偏光板が用いられている。ただし、有機化合物層から発した光が偏光板により反射されて内部に戻ることを防ぐため、屈折率を調節して内部反射の少ない構造とすることが好ましい。

【０１２０】なお、本実施例の発光装置に含まれる有機発光素子には、本発明で開示した有機発光素子のいずれを用いてもよい。

【０１２１】［実施例７］本実施例では、本発明で開示した有機発光素子を含む発光装置の例として、アクティブマトリクス型発光装置を例示するが、実施例６とは異なり、能動素子が形成されている基板とは反対側から光を取り出す構造（以下、「上方出射」と記す）の発光装置を示す。図１９にその断面図を示す。

【０１２２】なお、能動素子としてここでは薄膜トランジスタ（以下、「TFT」と記す）を用いているが、MOSトランジスタを用いてもよい。また、TFTとしてトップゲート型TFT（具体的にはプレーナ型TFT）を例示するが、ボトムゲート型TFT（典型的には逆スタガ型TFT）を用いることもできる。

【０１２３】本実施例において、基板1901、画素部に形成された電流制御TFT1902、および駆動回路1912に関しては、実施例６と同様の構成でよい。

【０１２４】電流制御TFT1902のドレインに接続されている第一電極1903であるが、本実施例では陽極として用いるため、仕事関数がより大きい導電性材料を用いることが好ましい。その代表例として、ニッケル、パラジウム、タングステン、金、銀などの金属が挙げられる。本実施例では、第一電極1903は光を透過しないことが好ましいが、それに加えて、光の反射性の高い材料を用いることがさらに好ましい。

【０１２５】第一電極1903の上には有機化合物層1904が設けられている。さらに、有機化合物層1904の上には第二電極1905が設けられており、本実施例では陰極とする。その場合、第二電極1905の材料としては、仕事関数が2.5～3.5eVの導電性材料を用いることが望ましい。代表的には、アルカリ金属元素もしくはアルカリ度類金属元素を含む導電膜、アルミニウムを含む導電膜、あるいはその導電膜にアルミニウムや銀などを積層したもの、を用いればよい。ただし、本実施例は上方出射であるため、第二電極1905が光透過性であることが大前提である。したがって、これらの金属を用いる場合は、20nm程度の超薄膜であることが好ましい。

【０１２６】また、第一電極1903、有機化合物層1904、および第二電極1905からなる層は、保護膜1906で覆われている。保護膜1906は、有機発光素子を酸素および水から保護するために設けられている。本実施例では、光を透過するものであればいかなるものを用いてもよい。

【０１２７】なお、図１９では電流制御TFT1902に第一電極（陽極）1903が電気的に接続されているが、陰極が電流制御TFTに接続された構造をとることもできる。その場合、第一電極を陰極の材料で形成し、第二電極を陽極の材料で形成すればよい。このとき、電流制御TFTはnチャネル型TFTとすることが好ましい。

【０１２８】さらに、1907はカバー材であり、樹脂からなるシール材1908により接着されている。カバー材1907は酸素および水を透過しない材質で、かつ、光を透過する材質であればいかなるものを用いてもよい。本実施例ではガラスを用いる。密閉空間1909は不活性ガス（代表的には窒素ガスや希ガス）、樹脂または不活性液体（例えばパーフルオロアルカンに代表される液状のフッ素化炭素）を充填しておけばよい。さらに、吸湿剤や脱酸素剤を設けることも有効である。

【０１２９】なお、ゲート信号側駆動回路およびデータ信号側駆動回路に伝送される信号は、入力配線1913を介してTAB（Tape Automated Bonding）テープ1914から入力される。なお、図示しないが、TABテープ1414の代わりに、TABテープにIC（集積回路）を設けたTCP（Tape Carrier Package）を接続してもよい。

【０１３０】また、本実施例に示した発光装置の表示面（画像を観測する面）に偏光板をもうけてもよい。この偏光板は、外部から入射した光の反射を押さえ、観測者が表示面に映り込むことを防ぐ効果がある。一般的には、円偏光板が用いられている。ただし、有機化合物層から発した光が偏光板により反射されて内部に戻ることを防ぐため、屈折率を調節して内部反射の少ない構造とすることが好ましい。

【０１３１】なお、本実施例の発光装置に含まれる有機発光素子には、本発明で開示した有機発光素子のいずれを用いてもよい。

【０１３２】［実施例８］本実施例では、本発明で開示した有機発光素子を含む発光装置の例として、パッシブマトリクス型発光装置を例示する。図１２(a)にはその上面図を示し、図１２(b)には図１２(a)をP－P'で切断した時の断面図を示す。

【０１３３】図１２(a)において、1201は基板であり、

ここではプラスチック材を用いる。プラスチック材としては、ポリイミド、ポリアミド、アクリル樹脂、エポキシ樹脂、PES（ポリエーテルスルホン）、PC（ポリカーボネート）、PET（ポリエチレンテレフタレート）もしくはPEN（ポリエーテルニトリル）を板状、もしくはフィルム上にしたものが使用できる。

【０１３４】1202は酸化導電膜からなる走査線（陽極）であり、本実施例では酸化亜鉛に酸化ガリウムを添加した酸化物導電膜を用いる。また、1203は金属膜からなるデータ線（陰極）であり、本実施例ではビスマス膜を用いる。また、1204はアクリル樹脂からなるバンクであり、データ線1203を分断するための隔壁として機能する。走査線1202とデータ線1203は両方とも、ストライプ状に複数形成されており、互いに直交するように設けられている。なお、図１２(a)では図示していないが、走査線1202とデータ線1203の間には有機化合物層が挟まれており、交差部1205が画素となる。

【０１３５】そして、走査線1202およびデータ線1203はTABテープ1207を介して外部の駆動回路に接続される。なお、1208は走査線1202が集合してなる配線群を表しており、1209はデータ線1203に接続された接続配線1206の集合からなる配線群を表す。また、図示していないが、TABテープ1207の代わりに、TABテープにICを設けたTCPを接続してもよい。

【０１３６】また、図１２(b)において、1210はシール材、1211はシール材1210によりプラスチック材1201に貼り合わされたカバー材である。シール材1210としては光硬化樹脂を用いていればよく、脱ガスが少なく、吸湿性の低い材料が望ましい。カバー材としては基板1201と同一の材料が好ましく、ガラス（石英ガラスを含む）もしくはプラスチックを用いることができる。ここではプラスチック材を用いる。

【０１３７】次に、画素領域の構造の拡大図を図１２(c)に示す。1213は有機化合物層である。なお、図１２(c)に示すように、バンク1204は下層の幅が上層の幅よりも狭い形状になっており、データ線1203を物理的に分断できる。また、シール材1210で囲まれた画素部1214は、樹脂からなる封止材1215により外気から遮断され、有機化合物層の劣化を防ぐ構造となっている。

【０１３８】以上のような構成からなる本発明の発光装置は、画素部1214が走査線1202、データ線1203、バンク1204および有機化合物層1213で形成されるため、非常に簡単なプロセスで作製することができる。

【０１３９】また、本実施例に示した発光装置の表示面（画像を観測する面）に偏光板をもうけてもよい。この偏光板は、外部から入射した光の反射を押さえ、観測者が表示面に映り込むことを防ぐ効果がある。一般的には、円偏光板が用いられている。ただし、有機化合物層から発した光が偏光板により反射されて内部に戻ることを防ぐため、屈折率を調節して内部反射の少ない構造とすることが好ましい。

【０１４０】なお、本実施例の発光装置に含まれる有機発光素子には、本発明で開示した有機発光素子のいずれを用いてもよい。

【０１４１】［実施例９］本実施例では、実施例８で示した発光装置にプリント配線板を設けてモジュール化した例を示す。

【０１４２】図１３(a)に示すモジュールは、基板1301（ここでは、画素部1302、配線1303a、 1303bを含む）にTABテープ1304が取り付けられ、前記TABテープ1304を介してプリント配線板1305が取り付けられている。

【０１４３】ここで、プリント配線板1305の機能ブロック図を図１３(b)に示す。プリント配線板1305の内部には少なくともI/Oポート（入力もしくは出力部）1306、1309、データ信号側駆動回路1307およびゲート信号側回路1308として機能するICが設けられている。

【０１４４】このように、基板面に画素部が形成された基板にTABテープが取り付けられ、そのTABテープを介して駆動回路としての機能を有するプリント配線版が取り付けられた構成のモジュールを、本明細書では特に駆動回路外付け型モジュールと呼ぶことにする。

【０１４５】なお、本実施例の発光装置に含まれる有機発光素子には、本発明で開示した有機発光素子のいずれを用いてもよい。

【０１４６】［実施例１０］本実施例では、実施例６もしくは実施例７もしくは実施例８に示した発光装置にプリント配線板を設けてモジュール化した例を示す。

【０１４７】図１４(a)に示すモジュールは、基板1401（ここでは、画素部1402、データ信号側駆動回路1403、ゲート信号側駆動回路1404、配線1403a、 1404aを含む）にTABテープ1405が取り付けられ、そのTABテープ1405を介してプリント配線板1406が取り付けられている。プリント配線板1406の機能ブロック図を図１４(b)に示す。

【０１４８】図１４(b)に示すように、プリント配線板1406の内部には少なくともI/Oポート1407、 1410、コントロール部1408として機能するICが設けられている。なお、ここではメモリ部1409を設けてあるが、必ずしも必要ではない。またコントロール部1408は、駆動回路の制御、映像データの補正などをコントロールするための機能を有した部位である。

【０１４９】このように、有機発光素子の形成された基板にコントローラーとしての機能を有するプリント配線板が取り付けられた構成のモジュールを、本明細書では特にコントローラー外付け型モジュールと呼ぶことにする。

【０１５０】なお、本実施例の発光装置に含まれる有機発光素子には、本発明で開示した有機発光素子のいずれを用いてもよい。

【０１５１】［実施例１１］本実施例では、本発明で開

示した有機発光素子を、デジタル時間階調表示により定電圧にて駆動する発光装置の例を示す。

【０１５２】有機発光素子を用いた画素の、回路構成を図１７(a)に示す。Trはトランジスタ、Csはストレージキャパシタを表す。図１７(a)中の回路構成では、ソース線はトランジスタTr1のソース側に、ゲート線はトランジスタTr1のゲートに接続されている。また、電源供給線はストレージキャパシタCs、およびトランジスタTr2のソース側に接続されている。トランジスタTr2のドレイン側には本発明の有機発光素子の陽極が接続されているため、有機発光素子を挟んでトランジスタTr2の反対側は、陰極となっている。

【０１５３】この回路においては、ゲート線が選択されると、電流がソース線からTr1に流れ、その信号に対応する電圧がCsに蓄積される。そして、Tr2のゲートおよびソース間の電圧（V_{gs}）により制御される電流が、Tr2および有機発光素子に流れることになる。

【０１５４】Tr1が選択されたあとは、Tr1はオフ状態となり、Csの電圧（V_{gs}）が保持される。したがって、V_{gs}に依存するだけの電流を流し続けることができる。

【０１５５】このような回路を、デジタル時間階調表示により駆動するチャートを図１７(b)に示す。すなわち、１フレームを複数のサブフレームに分割するわけだが、図１７(b)では、１フレームを６つのサブフレーム（SF1～SF6）に分割する６ビット階調とした。TAは書き込み時間である。この場合、それぞれのサブフレーム発光期間の割合は、図に示したように３２：１６：８：４：２：１となる。

【０１５６】本実施例におけるTFT基板の駆動回路の概要を図１７(c)に示す。図１７(c)中の基板構成では、本発明の有機発光素子を各画素とした画素部に対し、図１７(a)で示したような電源供給線および陰極が接続されている。また、シフトレジスタは、シフトレジスタ→ラッチ１→ラッチ２→画素部の順で、画素部に接続されている。ラッチ１にはデジタル信号が入力され、ラッチ２に入力されるラッチパルスによって画像データを画素部に送り込むことができる。

【０１５７】ゲートドライバおよびソースドライバは同じ基板上に設けられており、画素回路およびドライバは、デジタル駆動するように設計されているため、TFT特性のばらつきの影響を受けることなく、均一な像を得ることができる。

【０１５８】［実施例１２］本実施例では、本発明で開示した有機発光素子に一定の電流を流すことにより駆動する、アクティブマトリクス型の定電流駆動回路の例を示す。その回路構成を図１８に示す。

【０１５９】図１８に示す画素１８１０は、信号線Ｓｉ、第１走査線Ｇｊ、第２走査線Ｐｊ及び電源線Ｖｉを有している。また画素１８１０は、Ｔｒ１、Ｔｒ２、Ｔｒ３、Ｔｒ４、混合接合型の有機発光素子１８１１及び保持容量１８１２を有している。

【０１６０】Ｔｒ３とＴｒ４のゲートは、共に第１走査線Ｇｊに接続されている。Ｔｒ３のソースとドレインは、一方は信号線Ｓｉに、もう一方はＴｒ２のソースに接続されている。またＴｒ４のソースとドレインは、一方はＴｒ２のソースに、もう一方はＴｒ１のゲートに接続されている。つまり、Ｔｒ３のソースとドレインのいずれか一方と、Ｔｒ４のソースとドレインのいずれか一方とは、接続されている。

【０１６１】Ｔｒ１のソースは電源線Ｖｉに、ドレインはＴｒ２のソースに接続されている。Ｔｒ２のゲートは第２走査線Ｐｊに接続されている。そしてＴｒ２のドレインは有機発光素子１８１１が有する画素電極に接続されている。有機発光素子１８１１は、画素電極と、対向電極と、画素電極と対向電極の間に設けられた有機発光層とを有している。有機発光素子１８１１の対向電極は発光パネルの外部に設けられた電源によって一定の電圧が与えられている。

【０１６２】なお、Ｔｒ３とＴｒ４は、ｎチャネル型ＴＦＴとｐチャネル型ＴＦＴのどちらでも良い。ただし、Ｔｒ３とＴｒ４の極性は同じである。また、Ｔｒ１はｎチャネル型ＴＦＴとｐチャネル型ＴＦＴのどちらでも良い。Ｔｒ２は、ｎチャネル型ＴＦＴとｐチャネル型ＴＦＴのどちらでも良い。発光素子の画素電極と対向電極は、一方が陽極であり、他方が陰極である。Ｔｒ２がｐチャネル型ＴＦＴの場合、陽極を画素電極として用い、陰極を対向電極として用いるのが望ましい。逆に、Ｔｒ２がｎチャネル型ＴＦＴの場合、陰極を画素電極として用い、陽極を対向電極として用いるのが望ましい。

【０１６３】保持容量１８１２はＴｒ１のゲートとソースとの間に形成されている。保持容量１８１２はＴｒ１のゲートとソースの間の電圧（V_{GS}）をより確実に維持するために設けられているが、必ずしも設ける必要はない。

【０１６４】図１８に示した画素では、信号線Ｓｉに供給される電流を信号線駆動回路が有する電流源において制御されている。

【０１６５】以上のような回路構成を適用することにより、有機発光素子に一定の電流を流して輝度を一定に保とうとする定電流駆動が可能となる。本発明で開示した混合領域を有する有機発光素子は従来の有機発光素子に比べて寿命が長いが、上記のような定電流駆動を実施することでさらに長寿命化を図ることができるため、有効である。

【０１６６】［実施例１３］上記実施例で述べた本発明の発光装置は、低消費電力で寿命が長いという利点を有する。したがって、前記発光装置が表示部等として含まれる電気器具は、従来よりも低い消費電力で動作可能であり、なおかつ長保ちする電気器具となる。特に電源としてバッテリーを使用する携帯機器のような電気器具に関

しては、低消費電力化が便利さに直結する（電池切れが起こりにくい）ため、極めて有用である。

【０１６７】また、前記発光装置は、自発光型であることから液晶表示装置のようなバックライトは必要なく、有機化合物層の厚みも１μｍに満たないため、薄型軽量化が可能である。したがって、前記発光装置が表示部等として含まれる電気器具は、従来よりも薄型軽量な電気器具となる。このことも、特に携帯機器のような電気器具に関して、便利さ（持ち運びの際の軽さやコンパクトさ）に直結するため、極めて有用である。さらに、電気器具全般においても、薄型である（かさばらない）ことは運送面（大量輸送が可能）、設置面（部屋などのスペース確保）からみても有用であることは疑いない。

【０１６８】なお、前記発光装置は自発光型であるために、液晶表示装置に比べて明るい場所での視認性に優れ、しかも視野角が広いという特徴を持つ。したがって、前記発光装置を表示部として有する電気器具は、表示の見やすさの点でも大きなメリットがある。

【０１６９】すなわち、本発明の発光装置を用いた電気器具は、薄型軽量・高視認性といった従来の有機発光素子の長所に加え、低消費電力・長寿命という特長も保有しており、極めて有用である。

【０１７０】本実施例では、本発明の発光装置を表示部として含む電気器具を例示する。その具体例を図１５および図１６に示す。なお、本実施例の電気器具に含まれる有機発光素子には、本発明で開示した素子のいずれを用いてもよい。また、本実施例の電気器具に含まれる発光装置の形態は、図８～図１４のいずれの形態を用いても良い。

【０１７１】図１５(a)は有機発光素子を用いたディスプレイであり、筐体1501a、支持台1502a、表示部1503aを含む。本発明の発光装置を表示部1503aとして用いたディスプレイを作製することにより、薄く軽量で、長保ちするディスプレイを実現できる。よって、輸送が簡便になり、設置の際の省スペースが可能となる上に、寿命も長い。

【０１７２】図１５(b)はビデオカメラであり、本体1501b、表示部1502b、音声入力部1503b、操作スイッチ1504b、バッテリー1505b、受像部1506bを含む。本発明の発光装置を表示部1502bとして用いたビデオカメラを作製することにより、消費電力が少なく、軽量なビデオカメラを実現できる。よって、電池の消費量が少なくなり、持ち運びも簡便になる。

【０１７３】図１５(c)はデジタルカメラであり、本体1501c、表示部1502c、接眼部1503c、操作スイッチ1504cを含む。本発明の発光装置を表示部1502cとして用いたデジタルカメラを作製することにより、消費電力が少なく、軽量なデジタルカメラを実現できる。よって、電池の消費量が少なくなり、持ち運びも簡便になる。

【０１７４】図１５(d)は記録媒体を備えた画像再生装置であり、本体1501d、記録媒体（CD、LD、またはDVDなど）1502d、操作スイッチ1503d、表示部(A)1504d、表示部(B)1505dを含む。表示部(A)1504dは主として画像情報を表示し、表示部(B)1505dは主として文字情報を表示する。本発明の発光装置をこれら表示部(A)1504dや表示部(B)1505dとして用いた前記画像再生装置を作製することにより、消費電力が少なく軽量な上に、長保ちする前記画像再生装置を実現できる。なお、この記録媒体を備えた画像再生装置には、CD再生装置、ゲーム機器なども含む。

【０１７５】図１５(e)は携帯型（モバイル）コンピュータであり、本体1501e、表示部1502e、受像部1503e、操作スイッチ1504e、メモリスロット1505eを含む。本発明の発光装置を表示部1502eとして用いた携帯型コンピュータを作製することにより、消費電力が少なく、薄型軽量な携帯型コンピュータを実現できる。よって、電池の消費量が少なくなり、持ち運びも簡便になる。なお、この携帯型コンピュータはフラッシュメモリや不揮発性メモリを集積化した記録媒体に情報を記録したり、それを再生したりすることができる。

【０１７６】図１５(f)はパーソナルコンピュータであり、本体1501f、筐体1502f、表示部1503f、キーボード1504fを含む。本発明の発光装置を表示部1503fとして用いたパーソナルコンピュータを作製することにより、消費電力が少なく、薄型軽量なパーソナルコンピュータを実現できる。特に、ノートパソコンのように持ち歩く用途が必要な場合、電池の消費量や軽さの点で大きなメリットとなる。

【０１７７】なお、上記電気器具はインターネットなどの電子通信回線や電波などの無線通信を通じて配信される情報を表示することが多くなってきており、特に動画情報を表示する機会が増えている。有機発光素子の応答速度は非常に速く、そのような動画表示に好適である。

【０１７８】次に、図１６(a)は携帯電話であり、本体1601a、音声出力部1602a、音声入力部1603a、表示部1604a、操作スイッチ1605a、アンテナ1606aを含む。本発明の発光装置を表示部1604aとして用いた携帯電話を作製することにより、消費電力が少なく、薄型軽量な携帯電話を実現できる。よって、電池の消費量が少なくなり、持ち運びも楽になる上にコンパクトな本体にできる。

【０１７９】図１６(b)は音響機器（具体的には車載用オーディオ）であり、本体1601b、表示部1602b、操作スイッチ1603b、1604bを含む。本発明の発光装置を表示部1602bとして用いた音響機器を作製することにより、消費電力が少なく、軽量な音響機器を実現できる。また、本実施例では車載用オーディオを例として示すが、家庭用オーディオに用いても良い。

【０１８０】なお、図１５～図１６で示したような電気器具において、さらに光センサを内蔵させ、使用環境の明るさを検知する手段を設けることで、使用環境の明る

さに応じて発光輝度を変調させるような機能を持たせることは有効である。使用者は、使用環境の明るさに比べてコントラスト比で100～150の明るさを確保できれば、問題なく画像もしくは文字情報を認識できる。すなわち、使用環境が明るい場合は画像の輝度を上げて見やすくし、使用環境が暗い場合は画像の輝度を抑えて消費電力を抑えるといったことが可能となる。

【０１８１】また、本発明の発光装置を光源として用いた様々な電気器具も、低消費電力での動作や薄型軽量化が可能であるため、非常に有用と言える。代表的には、液晶表示装置のバックライトもしくはフロントライトといった光源、または照明機器の光源として本発明の発光装置を含む電気器具は、低消費電力の実現や薄型軽量化が可能である。

【０１８２】したがって、本実施例に示した図１５～図１６の電気器具の表示部を、全て液晶ディスプレイにする場合においても、その液晶ディスプレイのバックライトもしくはフロントライトとして本発明の発光装置を用いた電気器具を作製することにより、消費電力が少なく、薄くて軽量な電気器具が達成できる。

【０１８３】

【発明の効果】本発明を実施することで、消費電力が少ない上に、寿命も優れた発光装置を得ることができる。さらに、そのような発光装置を光源もしくは表示部に用いることで、明るく消費電力が少ない上に、長保ちする電気器具を得ることができる。

【図面の簡単な説明】

【図１】正孔注入層の役割を示す図。

【図２】有機発光素子の構成を示す図。

【図３】有機発光素子の構成を示す図。

【図４】有機化合物膜の断面TEM写真を示す図。

【図５】有機化合物膜の作製方法を示す図。

【図６】有機化合物膜の作製方法を示す図。

【図７】有機化合物膜の作製方法を示す図。

【図８】発光装置の断面構造を示す図。

【図９】発光装置の断面構造を示す図。

【図１０】発光装置の断面構造を示す図。

【図１１】発光装置の上面構造および断面構造を示す図。

【図１２】発光装置の上面構造および断面構造を示す図。

【図１３】発光装置の構成を示す図。

【図１４】発光装置の構成を示す図。

【図１５】電気器具の具体例を示す図。

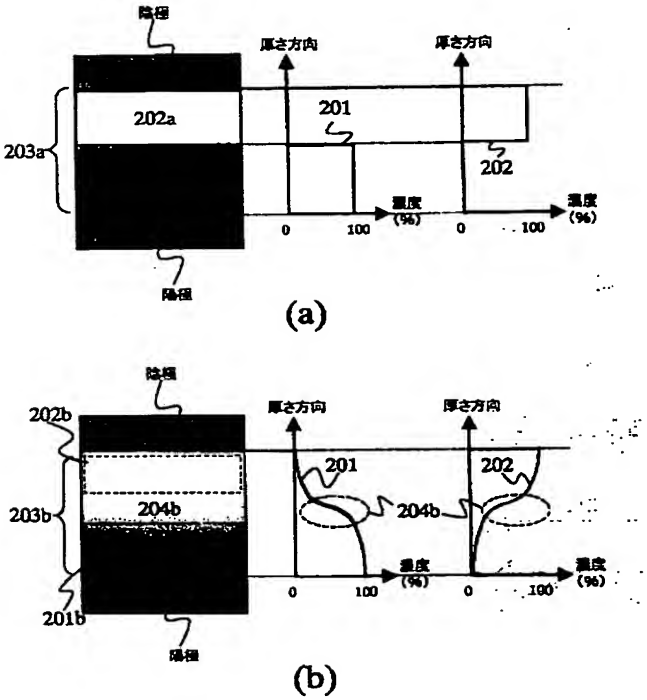
【図１６】電気器具の具体例を示す図。

【図１７】発光装置の回路構成を示す図。

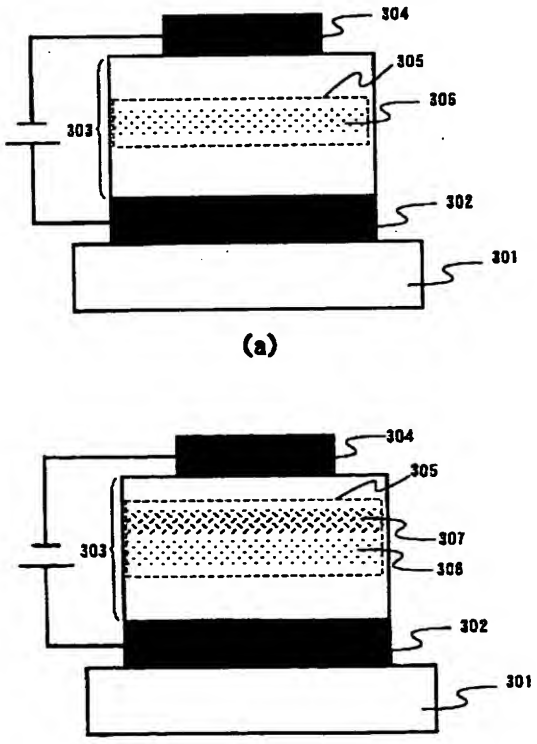
【図１８】発光装置の回路構成を示す図。

【図１９】発光装置の断面構造を示す図。

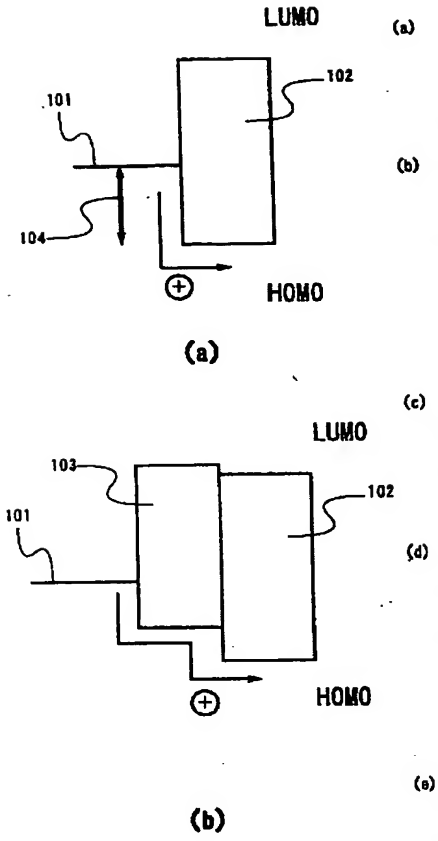
【図２】



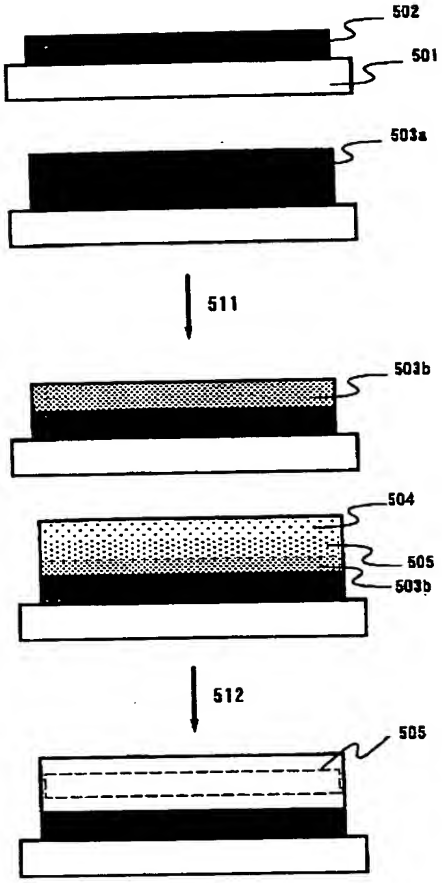
【図３】



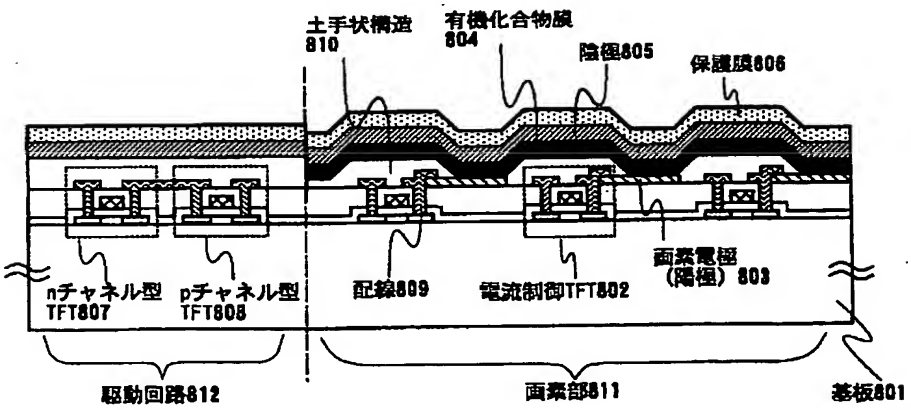
【図１】


LUMO
101
102
104
HOMO
(a)
LUMO
103
101
102
HOMO
(b)

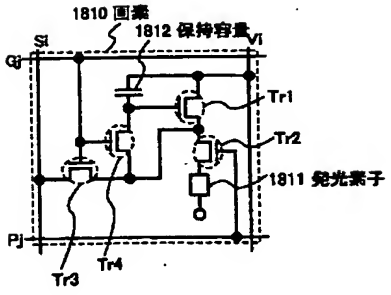
【図５】


(a)
502
501
(b)
503a
511
(c)
503b
(d)
504
505
503b
512
(e)
505

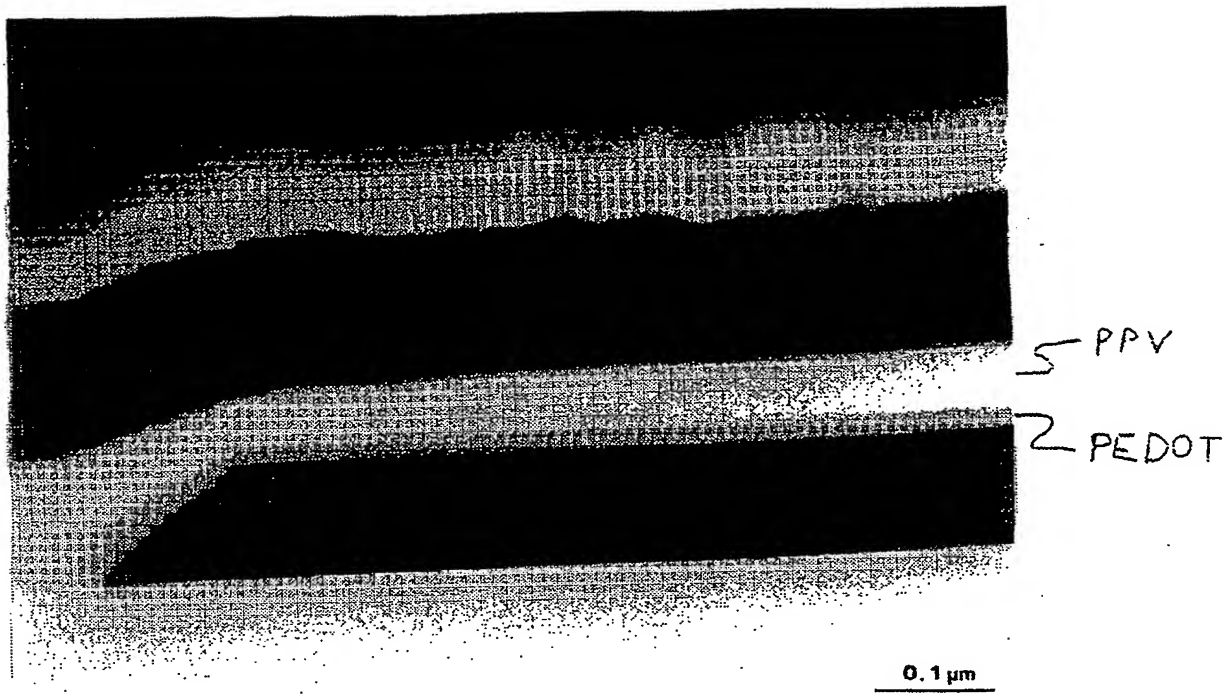
【図８】


土手状構造
810
有機化合物膜
804
陰極805
保護膜806
nチャネル型
TFT807
pチャネル型
TFT808
配線809
電流制御TFT802
画素電極
(陽極) 803
駆動回路812
画素部811
基板801

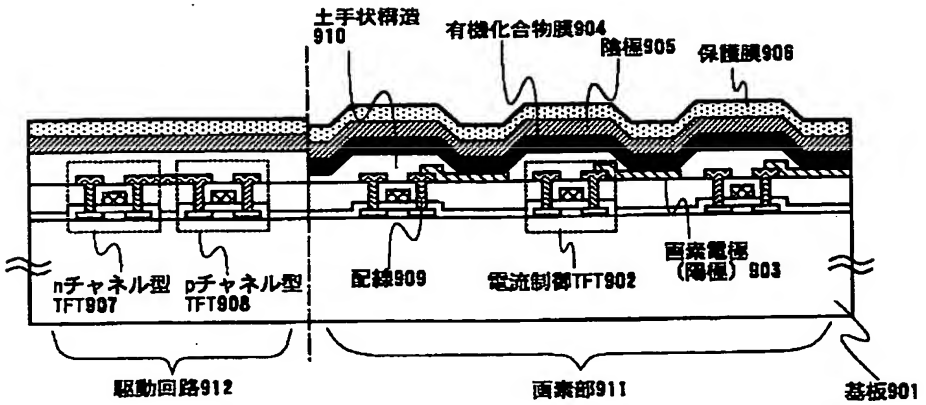
【図１８】


1810 画素
1812 保持容量
Si
Vi
Gi
Tr1
Tr2
1811 発光素子
Pj
Tr3
Tr4

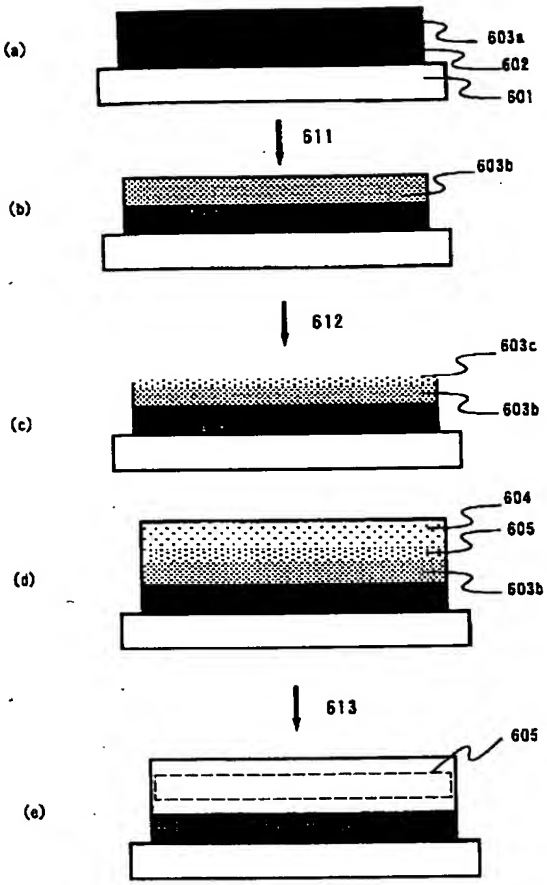
【図４】


5 PPV
2 PEDOT
0.1 μm

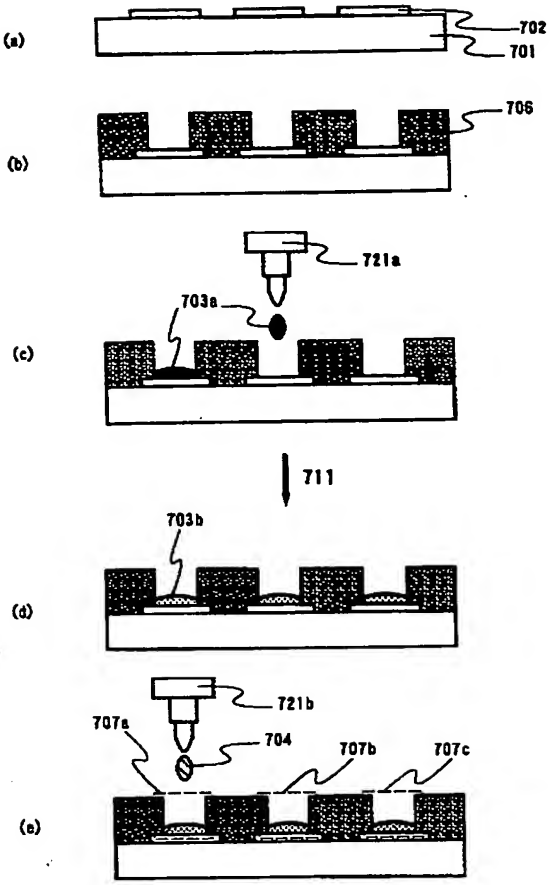
【図９】


土手状構造910
有機化合物膜904
陰極905
保護膜906
nチャネル型TFT907
pチャネル型TFT908
配線909
電流制御TFT902
画素電極（陽極）903
駆動回路912
画素部911
基板901

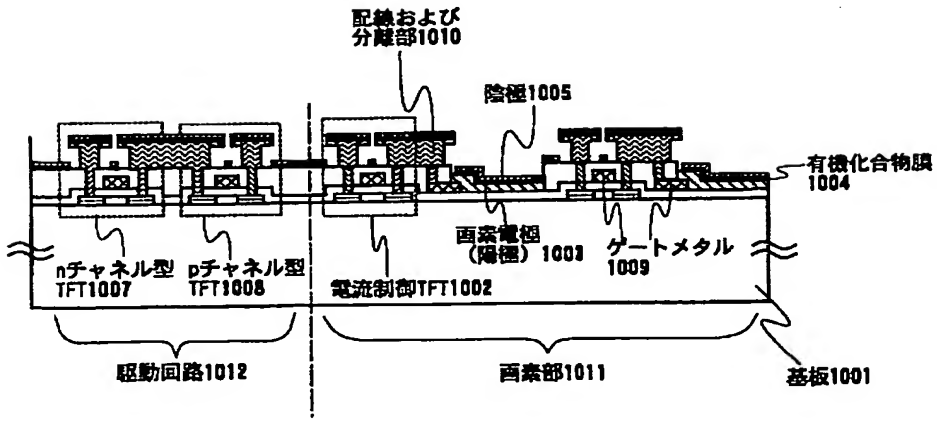
【図６】


(a)
603a
602
601
611
(b)
603b
612
(c)
603c
603b
(d)
604
605
603b
613
(e)
605

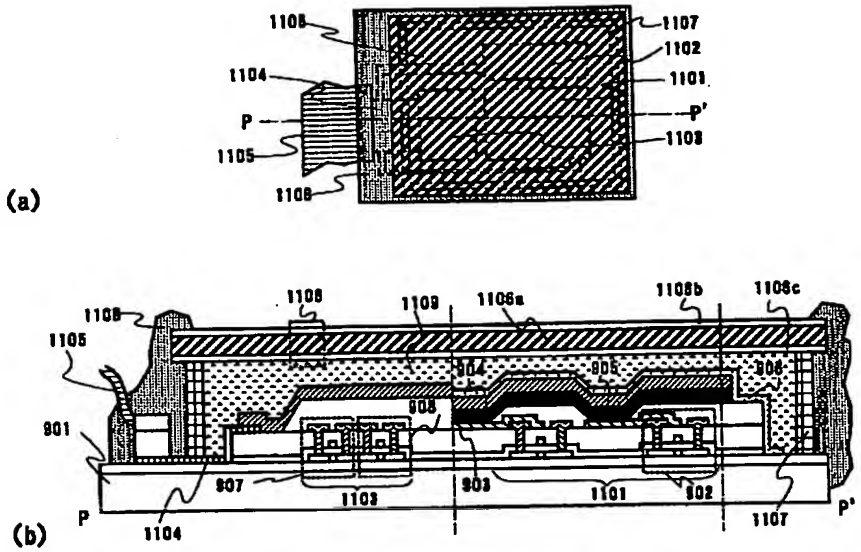
【図７】


(a)
702
701
(b)
706
721a
(c)
703a
711
(d)
703b
721b
707a
704
707b
707c
(e)

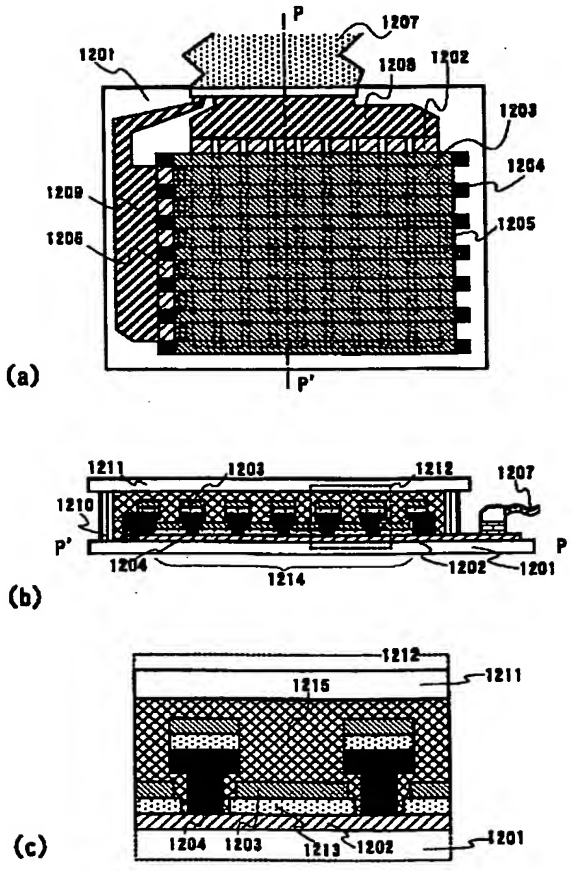
【図１０】


配線および
分離部1010
陰極1005
有機化合物膜
1004
画素電極
（陽極）1003
ゲートメタル
1009
nチャネル型
TFT1007
pチャネル型
TFT1008
電流制御TFT1002
駆動回路1012
画素部1011
基板1001

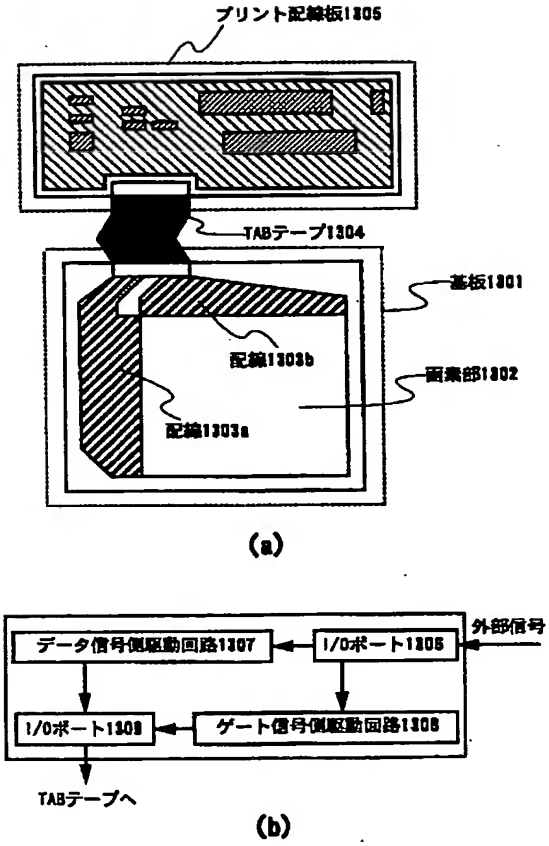
【図１１】


(a)
1106
1107
1102
1104
1101
P
P'
1105
1103
1108
(b)
1106
1109
1106a
1106b
1106c
1105
904
905
906
908
901
907
1103
903
1101
902
1107
P
P'
1104

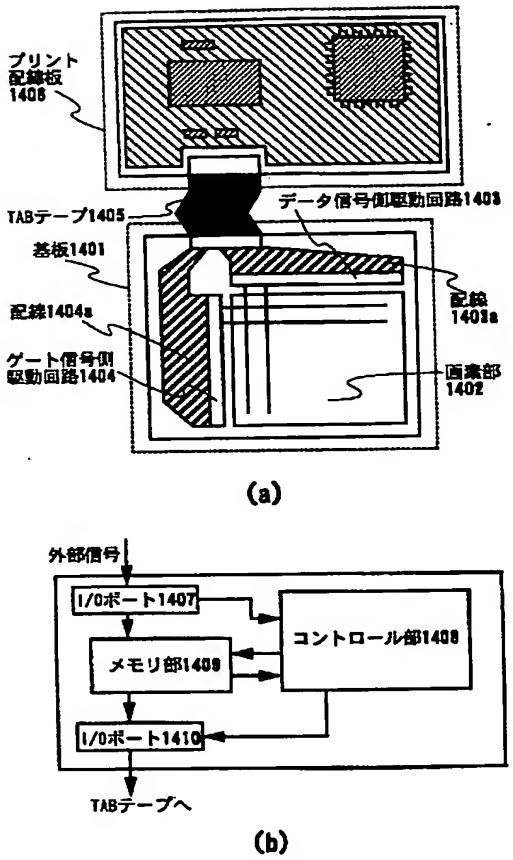
【図１２】


(a)
P
1207
1201
1208
1202
1203
1204
1209
1205
1206
P'
(b)
1211
1203
1212
1207
1210
P'
P
1204
1214
1202
1201
(c)
1212
1215
1211
1204
1203
1213
1202
1201

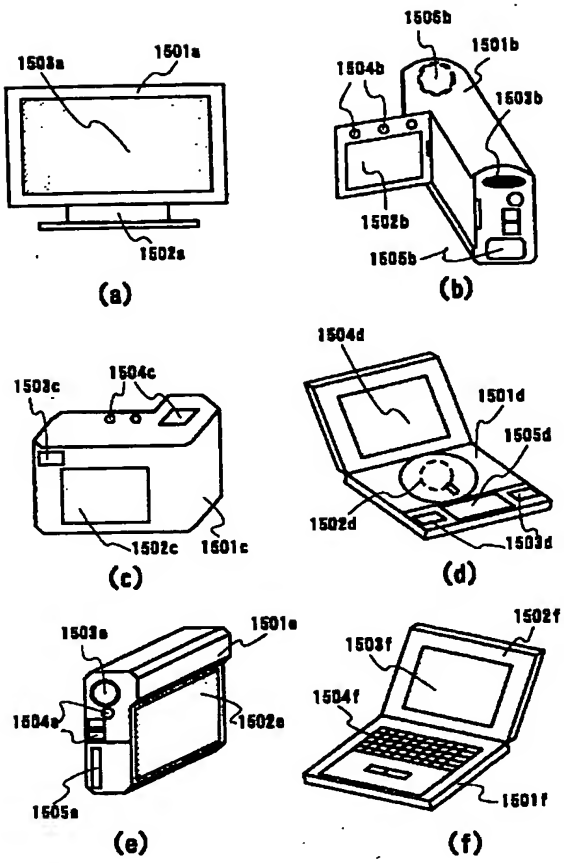
【図１３】


プリント配線板1305
TABテープ1304
基板1301
配線1303b
画素部1302
配線1303a
(a)
外部信号
データ信号側駆動回路1307
I/Oポート1305
I/Oポート1309
ゲート信号側駆動回路1308
TABテープへ
(b)

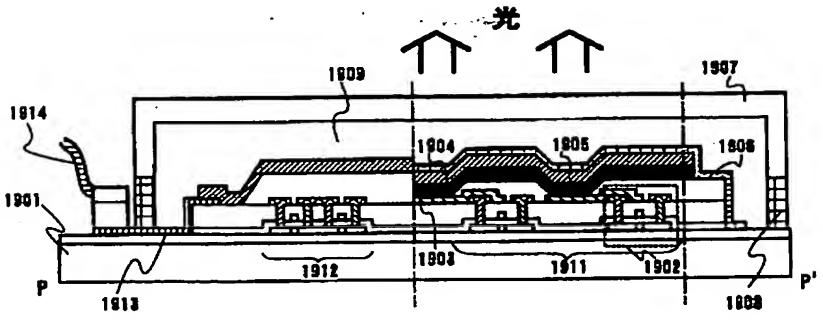
【図１４】


プリント
配線板
1408
TABテープ1405
データ信号側駆動回路1403
基板1401
配線
1403a
配線1404a
ゲート信号側
駆動回路1404
画素部
1402
(a)
外部信号
I/Oポート1407
コントロール部1408
メモリ部1409
I/Oポート1410
TABテープへ
(b)

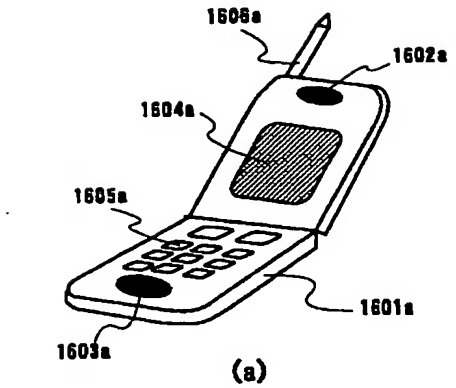
【図１５】


1503a
1501a
1502a
(a)
1505b
1501b
1504b
1503b
1502b
1505b
(b)
1503c
1504c
1502c
1501c
(c)
1504d
1501d
1505d
1502d
1503d
(d)
1503e
1501e
1504e
1502e
1505e
(e)
1502f
1503f
1504f
1501f
(f)

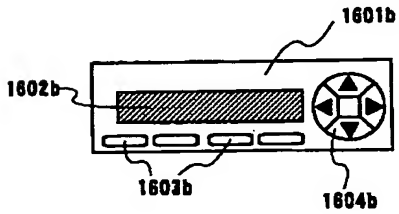
【図１９】


光
1909
1907
1914
1904
1905
1906
1901
1912
1903
1911
1902
P
P'
1913
1908

【図１６】

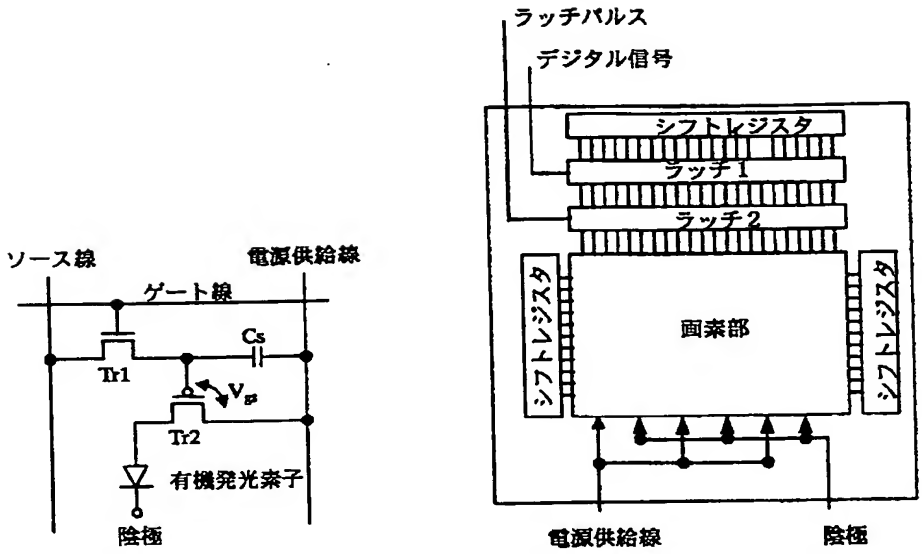

1606a
1602a
1604a
1605a
1601a
1603a

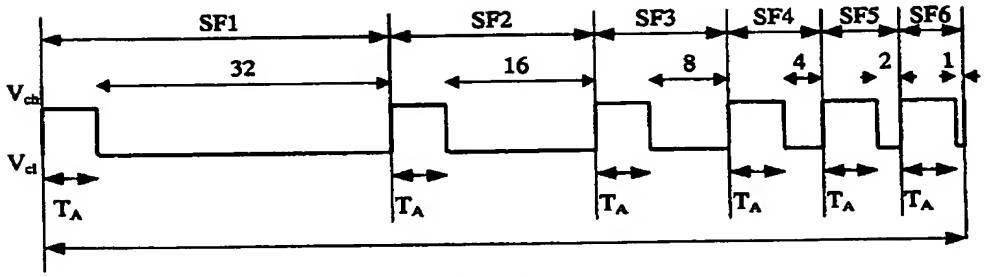
(a)


1601b
1602b
1603b
1604b

(b)

【図１７】





SF1-SF6:サブフレーム, T_A: 書き込み時間

(b)

フロントページの続き

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G09F	9/00	342	G09F	9/00	342Z
	9/30	365		9/30	365Z
H05B	33/10		H05B	33/10	
	33/22			33/22	B

D
Z

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EB00 FA01 GA04
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DA13 DB01 DB04 EA04 EA05
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GB10
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LL07

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G09F 9/00
G09F 9/30
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H05B 33/22

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(22)Date of filing : 17.01.2002

(71)Applicant : SEMICONDUCTOR ENERGY LAB CO LTD

(72)Inventor : SEO TETSUSHI
YAMAZAKI SHUNPEI

(30)Priority

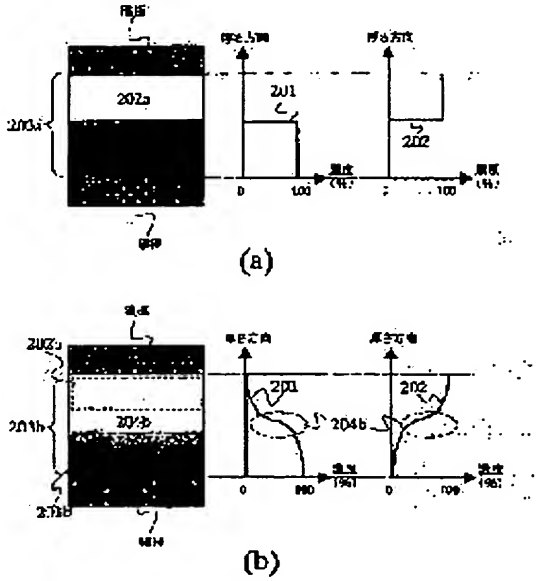
Priority number : 2001009544 Priority date : 17.01.2001 Priority country : JP

(54) LUMINESCENCE EQUIPMENT AND ITS MANUFACTURING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide luminescence equipment and an electrical apparatus having low power consumption and long life.

SOLUTION: In an organic compound film 203b, a domain 204b, in which concentration of a first organic compound 201 and concentration of a second organic compound 202 are changing gradually, is prepared. In addition, by forming a structure, where a domain 201b, which the first organic compound can develop its function, and a domain 202b, which the second organic compound can develop its function, exist, the functions of each materials can be developed. By this technique, an organic light emitting element of low power consumption and long life is provided, and the luminescence equipment and the electrical apparatus are produced using the above organic light emitting element.



LEGAL STATUS

[Date of request for examination]	08.10.2004
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] In the luminescence equipment containing the organic light emitting device which has the organic compound film inserted between an anode plate, cathode, and said anode plate and said cathode said organic compound film The hole injectional compound which receives an electron hole from said anode plate, the electron injectional compound which receives an electron from said cathode, The blocking nature compound which can prevent migration of an electron hole transportability compound, an electronic transportability compound, an electron hole, or an electron, It is luminescence equipment which contains at least two compounds chosen from a group of luminescent compound ** which presents luminescence, and is characterized by at least one of said two compounds being a high molecular compound.
[Claim 2] The field which said two compounds are mixing in luminescence equipment according to claim 1 is luminescence equipment characterized by existing in the location distant from said anode plate and said cathode.
[Claim 3] It is luminescence equipment which said two compounds are hosts in luminescence equipment according to claim 1 or 2, and is characterized by the guest being added by the field which said two compounds are mixing.
[Claim 4] It is luminescence equipment characterized by being the luminescent compound with which said guest presents luminescence in claim 3.
[Claim 5] The first organic compound said organic compound film of whose is a high molecular compound in the organic compound film inserted between an anode plate, cathode, and said anode plate and said cathode and the luminescence equipment containing the organic light emitting device which carries out WO **, and said first organic compound are luminescence equipment characterized by to have the mixing zone which contains the second organic compound which is a different high molecular compound, and said the first organic compound and said second organic compound are mixing.
[Claim 6] It is luminescence equipment characterized by having the mixing zone which said organic compound film contains the first organic compound which is a high molecular compound, and the second organic compound which is a low molecular weight compound in which vacuum deposition is possible in the luminescence equipment containing the organic light emitting device which has the organic compound film inserted between an anode plate, cathode, and said anode plate and said cathode, and said the first organic compound and said second organic compound are mixing.
[Claim 7] Luminescence equipment with which concentration of said first organic compound and concentration of said second organic compound are characterized by changing continuously into said mixing zone in luminescence equipment according to claim 5.
[Claim 8] Luminescence equipment with which concentration of said first organic compound and concentration of said second organic compound are characterized by changing continuously into said mixing zone in luminescence equipment according to claim 6.
[Claim 9] It is luminescence equipment characterized by existing in the location where said first organic compound is electron hole transportability, and said second organic compound is a luminescence which presents luminescence in luminescence equipment according to claim 5 or 7, and said mixing zone separated from said anode plate and said cathode.
[Claim 10] It is luminescence equipment characterized by existing in the location where said first organic compound is electronic transportability, and said second organic compound is a luminescence which presents luminescence in luminescence equipment according to claim 5 or 7, and said mixing

zone separated from said anode plate and said cathode.
[Claim 11] It is luminescence equipment characterized by existing in the location where said first organic compound is electron hole transportability, and said second organic compound is a luminescence which presents luminescence in luminescence equipment according to claim 6 or 8, and said mixing zone separated from said anode plate and said cathode.
[Claim 12] It is luminescence equipment characterized by existing in the location where said first organic compound is electronic transportability, and said second organic compound is a luminescence which presents luminescence in luminescence equipment according to claim 6 or 8, and said mixing zone separated from said anode plate and said cathode.
[Claim 13] It is luminescence equipment characterized by for said first organic compound being a luminescence which presents luminescence in luminescence equipment according to claim 6 or 8, and for said second organic compound being electron hole transportability, and said mixing zone existing in the location distant from said anode plate and said cathode.
[Claim 14] It is luminescence equipment characterized by for said first organic compound being a luminescence which presents luminescence in luminescence equipment according to claim 6 or 8, and for said second organic compound being electronic transportability, and said mixing zone existing in the location distant from said anode plate and said cathode.
[Claim 15] It is luminescence equipment which is the high molecular compound with which said first organic compound contains a pi electron in luminescence equipment according to claim 9 to 12, and is characterized by performing chemistry doping.
[Claim 16] It is luminescence equipment characterized by said first organic compound being the poly thiophene derivative, the poly aniline derivative, or a polyvinyl-carbazole derivative in luminescence equipment according to claim 9 or 11.
[Claim 17] It is luminescence equipment characterized by said second organic compound being a poly para-phenylene vinylene derivative, the poly dialkyl fluorene derivative, a polyvinyl-carbazole derivative, or a polyphenylene derivative in luminescence equipment according to claim 9 or 10.
[Claim 18] It is luminescence equipment characterized by said second organic compound being a poly para-phenylene vinylene derivative, the poly dialkyl fluorene derivative, a polyvinyl-carbazole derivative, or a polyphenylene derivative in luminescence equipment according to claim 13 or 14.
[Claim 19] Said organic compound film is luminescence equipment characterized by being added as a guest by the field to which the third organic compound with which said first organic compound and said second organic compound differ from each other in luminescence equipment according to claim 5 to 18 is contained, and said third organic compound contains both said first organic compound and said second organic compound.
[Claim 20] It is luminescence equipment characterized by for said the first organic compound and said second organic compound to be the compound chosen from a group of blocking nature compound ** which can prevent migration of the hole injectional compound which receives an electron hole from said anode plate, the electron injectional compound which receives an electron from said cathode, an electron hole transportability compound, an electronic transportability compound, an electron hole, or an electron in luminescence equipment according to claim 19, and for said third organic compound to be the luminescent compound which presents luminescence.
[Claim 21] It is luminescence equipment characterized by being the luminescent compound with which said third organic compound presents luminescence from a triplet excitation state in claim 19 or luminescence equipment according to claim 20.
[Claim 22] It is luminescence equipment characterized by being the metal complex with which said third organic compound uses platinum as a central metal in luminescence equipment according to claim 21, or the metal complex which uses iridium as a central metal.
[Claim 23] It is luminescence equipment characterized by said third organic compound having the large energy difference of a highest occupied molecular orbital and a minimum sky molecular orbital in luminescence equipment according to claim 19 compared with said the first organic compound and said second organic compound.
[Claim 24] It is luminescence equipment characterized by said third organic compound being a phenanthroline derivative, an OKISA diazole derivative, or a triazole derivative in luminescence equipment according to claim 19.
[Claim 25] Luminescence equipment with which the amount of detection of said element detectable [with SIMS] among the elements which constitute said the first organic compound or said second

organic compound in luminescence equipment according to claim 7 or 8 is characterized by having the field which changes from said anode plate continuously to the direction of said cathode.
[Claim 26] It is luminescence equipment with which the amount of detection of said 15th group element which can detect said organic compound film by SIMS in luminescence equipment according to claim 7 or 8 including the 15th group element thru/or the 17th group element thru/or the 17th group element is characterized by having the field which changes from said anode plate continuously to the direction of said cathode.
[Claim 27] Luminescence equipment with which said 15th group element thru/or the 17th group element are characterized by being nitrogen, phosphorus, oxygen, sulfur, fluorine, chlorine, a bromine, or iodine in luminescence equipment according to claim 26.
[Claim 28] The detection field of said metallic element which said third organic compound is a metal complex which has a metallic element in luminescence equipment according to claim 19 or 20, and can be detected by SIMS is luminescence equipment characterized by being a field containing both said first organic compound and said second organic compound.
[Claim 29] It is luminescence equipment characterized by said metallic element being aluminum, zinc, or beryllium in luminescence equipment according to claim 28.
[Claim 30] It is luminescence equipment characterized by said metallic element being iridium or platinum in luminescence equipment according to claim 28.
[Claim 31] The manufacture approach of the luminescence equipment containing an organic light emitting device which carries out wet spreading of the 1st solution which consists of the 1st organic compound and 1st solvent to the substrate which has an electrode, and is characterized by to apply the 2nd solution which heats said 1st solution at the temperature from which the vapor pressure of said 1st solvent becomes below the pressure of an activity ambient atmosphere, and consists of the 2nd organic compound and 2nd solvent after that.
[Claim 32] The manufacture approach of the luminescence equipment containing an organic light emitting device characterized by to apply the 2nd solution which subsequently consists of conditions that the solvent contained in said 1st solution is contained in an activity ambient atmosphere after carrying out wet spreading and carrying out stoving of the 1st solution which consists of the 1st organic compound and 1st solvent to the substrate which has an electrode, with the 2nd organic compound and 2nd solvent.
[Claim 33] Solubility [as opposed to / in case wet spreading of the 2nd solution which consists of the 2nd organic compound and 2nd solvent is carried out after forming the 1st organic compound to the substrate which has an electrode / said 2nd solvent] is the manufacture approach of the luminescence equipment containing the organic light emitting device characterized by said 2nd organic compound being more expensive than said 1st organic compound.
[Claim 34] The manufacture approach of the luminescence equipment containing an organic light emitting device characterized by carrying out wet spreading of the 2nd solution which subsequently consists of conditions that the solvent which can dissolve said 1st organic compound is contained in an activity ambient atmosphere after forming the 1st organic compound to the substrate which has an electrode, with the 2nd organic compound and 2nd solvent.
[Claim 35] The manufacture approach of the luminescence equipment containing an organic light emitting device which forms the 2nd organic compound with vacuum deposition subsequently to in a vacuum tub, and is characterized by the thing [carrying out afterbaking desiccation] after carrying out wet spreading of the 1st solution which dissolved the 1st organic compound to the substrate which has an electrode.
[Claim 36] It is the manufacture approach of the luminescence equipment containing an organic light emitting device characterized by carrying out said stoving under reduced pressure of 10 - 4 pascals or less in the manufacture approach according to claim 35.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the luminescence equipment using the organic light emitting device which has an anode plate, cathode, and the film (it is hereafter described as the "organic compound film") containing the organic compound with which luminescence is obtained by adding electric field. this invention -- especially -- the organic compound film -- a high molecular compound -- containing -- the former -- driver voltage -- low -- in addition -- and it is related with the luminescence equipment using an organic light emitting device with a long life and its manufacture approach of a component. In addition, the luminescence equipment in this specification points out an image display device or a luminescence device using the organic light emitting device as a light emitting device. Moreover, the module with which a connector (FPC:Flexible printed circuit), for example, an anisotropic conductive film, a TAB (Tape Automated Bonding) tape, or TCP (Tape Carrier Package) was attached in the organic light emitting device, the module with which the printed wired board was prepared in the point of a TAB tape or TCP, or all the modules by which IC (integrated circuit) was directly mounted in the organic light emitting device by the COG (Chip OnGlass) method shall also be included in luminescence equipment.
[0002]
[Description of the Prior Art] An organic light emitting device is a component which emits light by adding electric field. It is said that the luminescent mechanism emits energy and emits light in case the electron hole poured in from the electron poured in from cathode by impressing an electrical potential difference to inter-electrode on both sides of the organic compound film and the anode plate recombines in the emission center in the organic compound film, the molecule (it is hereafter described as a "molecule exciton") of an excitation state is formed and the molecule exciton returns to a ground state.
[0003] In addition, as a class of molecule exciton which an organic compound forms, although a singlet excitation state and a triplet excitation state are possible, suppose that it contains also when which excitation state contributes to luminescence in this specification.
[0004] In such an organic light emitting device, the organic compound film is usually formed with a thin film to the extent that it is less than 1 micrometer. Moreover, since the organic compound film itself is the spontaneous light type component which emits light, a back light of an organic light emitting device which is used for the conventional liquid crystal display is also unnecessary. Therefore, an organic light emitting device is an advantage with big it being extremely producible to a thin light weight.
[0005] Moreover, considering the carrier mobility of the organic compound film, time amount after pouring in a carrier in the about 100-200nm organic compound film until it results in recombination is about dozens of nanoseconds, and even if it includes the process from the recombination of a carrier to luminescence, it results in luminescence to the order within a microsecond, for example. Therefore, it is one of the features that a speed of response is also very quick.
[0006] Furthermore, since an organic light emitting device is a light emitting device of a carrier impregnation mold, the drive with direct current voltage is possible for it, and a noise cannot produce it easily. About driver voltage, thickness of the organic compound film is first used as an about 100nm uniform super-thin film. Moreover, by choosing an electrode material which makes small the carrier impregnation obstruction over the organic compound film, and introducing hetero structure (two-layer structure) further Sufficient brightness of 100 cd/m2 was attained by 5.5V (). [reference 1:C.W.Tang and S.A.VanSlyke, "Organic electroluminescent diodes",] [Applied] Physics Letters, vol.51, No.12,

and 913-915 (1987).
[0007] From properties, such as such thin light weight, high-speed responsibility, direct-current low-battery drives, etc., the organic light emitting device attracts attention as a next-generation flat-panel display component. Moreover, it is a spontaneous light type, and since the angle of visibility is large, visibility is also comparatively good and it is thought that it is effective as a component used for the display screen of a pocket device.
[0008] By the way, although it is the configuration of the organic light emitting device shown in reference 1, it considers as the approach of making a carrier impregnation obstruction small first, and to the low top, a work function uses a comparatively stable Mg:Ag alloy for cathode, and is raising electronic impregnation nature. By this, it makes it possible to pour a lot of carriers into the organic compound film.
[0009] Furthermore, the recombination effectiveness of a carrier is raised by leaps and bounds as organic compound film by applying the single hetero structure of carrying out the laminating of the electronic transportability luminous layer which consists of an electron hole transportation layer which consists of a diamine compound, and tris (8-quinolinolato) aluminum (it is hereafter described as "Alq3"). This is explained as follows.
[0010] For example, in the case of the organic light emitting device which has only Alq3 monolayer, most electrons poured in from cathode since Alq3 was electronic transportability arrive at an anode plate, without recombining with an electron hole, and the effectiveness of luminescence is very bad. That is, in order to make the organic light emitting device of a monolayer emit light efficiently (or it drives by the low battery), it is necessary to use the ingredient (for it to be hereafter described as a "bipolar ingredient") which can convey both an electron and an electron hole with sufficient balance, and Alq3 does not fulfill the condition.
[0011] However, if terrorism structure is applied to a single like reference 1, the electron poured in from cathode will be blocked by the interface of an electron hole transportation layer and an electronic transportability luminous layer, and will be shut up into an electronic transportability luminous layer. Therefore, recombination of a carrier is efficiently performed by the electronic transportability luminous layer, and it results in efficient luminescence.
[0012] If the concept of the blocking function of such a carrier is developed, it will also become possible to control the recombination field of a carrier. By inserting the layer (electron hole blocking layer) which can block an electron hole between an electron hole transportation layer and an electronic transportation layer as the example, an electron hole is shut up in an electron hole transportation layer, and there is a report which succeeded in making the electron hole transportation layer emit light. (Reference 2:Yasunori KIJIMA, Nobutoshi ASAI and Shin-ichiro TAMURA, "A Blue Organic Light Emitting Diode", Japanese Journal of AppliedPhysics, Vol.38, 5274-5277 (1999)) .
[0013] Moreover, it can be said that it is the way of thinking of functional separation that, as for the organic light emitting device in reference 1, an electron hole transportation layer performs transportation of an electron hole so to speak, and an electronic transportability luminous layer performs electronic transportation and electronic luminescence. The concept of this functional separation further Between an electron hole transportation layer and an electronic transportation layer A luminous layer It developed into the design for terrorism structure (3 layer structure) to the double of inserting (). [reference 3:Chihaya ADACHI, Shizuo TOKITO, Tetsuo TSUTSUI and Shogo SAITO,] ["Electroluminescence] in Organic Films with Three-Layered Structure", Japanese Journal of Applied Physics, Vol.27, No.2, L269-L271 (1988).
[0014] As an advantage of such functional separation, it is in the point that it becomes unnecessary to give various functions (the luminescence, carrier transportability, carrier impregnation nature from an electrode, etc.) to one kind of organic material to coincidence, and a broad degree of freedom can be given to a molecular design etc., by carrying out functional separation (it becomes unnecessary for example, to look for a bipolar ingredient by force). That is, by combining respectively an ingredient with a sufficient luminescence property, the ingredient in which carrier transportability is excellent, I hear that high luminous efficiency can be attained easily, and it is.
[0015] It is widely used until the concept (a carrier blocking function or functional separation) of the laminated structure stated by reference 1 itself results [from these advantages] in current.
[0016]
[Problem(s) to be Solved by the Invention] However, since a laminated structure which was described above is junction between dissimilar material, in the interface, an energy barrier will surely produce it. If

an energy barrier exists, since migration of a carrier is barred in the interface, two troubles which are described below will be raised.

[0017] One is the point of becoming a failure towards the further reduction of driver voltage, first. In the current organic light emitting device, the direction of the component of monolayer structure using a conjugation polymer is actually excellent about driver voltage. it is reported that the top data (however, luminescence from a singlet excitation state comparison) in power effectiveness (unit : [lm/W]) are held (reference 4:Tetsuo Tsutsui --) A Japan Society of Applied Physics organic molecule and "bioelectronics subcommittee meeting magazine" Vol.11, No.1, P.8 (2000).

[0018] In addition, the conjugation polymer stated by reference 4 is a bipolar ingredient, and can attain level equivalent to a laminated structure about the recombination effectiveness of a carrier. Therefore, if even recombination effectiveness of a carrier is made to an EQC by using a bipolar ingredient etc., without using a laminated structure, the direction of monolayer structure with few interfaces shows [driver voltage] in practice that it becomes low.

[0019] For example, an ingredient which eases an energy barrier is inserted in an interface with an electrode. The impregnation nature of a carrier It raises. Driver voltage there is the approach of reducing (it TakeoWakimoto(es) reference 5: --) Yoshinori Fukuda and Kenichi Nagayama and Akira Yokoi, Hitoshi Nakada and and Masami Tsuchida and "Organic EL Cells Using Alkaline Metal Compoundsas Electron Injection Materials", IEEE TRANSACTIONS ON ELECTRON DEVICES, VOL.44, NO.8, 1245-1248 (1997). By reference 5, it has succeeded in reduction of driver voltage by using Li2O as an electronic injection layer.

[0020] However, it is related with the carrier migratory between organic materials (for example, it is a thing between an electron hole transportation layer and a luminous layer, and is hereafter described as "an organic interface"), and it is still thought that it is an unsolved field and is the important point for catching up with the low driver voltage of monolayer structure.

[0021] Furthermore, the effect to the component life of an organic light emitting device can be considered as another trouble resulting from an energy barrier. That is, it is the fall of the brightness by migration of a carrier being barred and charge being accumulated.

[0022] By inserting a hole injection layer between an anode plate and an electron hole transportation layer, and making it further ac drive of a square wave instead of dc drive, although the theory which clarified about this degradation device is not established The fall of brightness There is a report that it can stop (). [reference 6:S.] A.VanSlyke and C.H.Chen, and C.W.Tang and "Organic electroluminescentdevices with improved stability", Applied Physics Letters, Vol.69, No.15, 2160-2162 (1996). This can be said to be experimental backing that the fall of brightness was able to be suppressed, by eliminating are recording of charge by insertion and ac drive of a hole injection layer.

[0023] the above thing to a laminated structure -- easy -- the recombination effectiveness of a carrier -- it can raise -- in addition -- and while it has the merit that selection width of face of an ingredient can be made large from a viewpoint of functional separation, by making many organic interfaces, migration of a carrier is barred and it can be said that the fall of driver voltage or brightness is affected.

[0024] then -- at the same time it eases the energy barrier which exists in the organic compound film by producing the component of a concept which is different from the laminated structure used conventionally in this invention and raises migratory [of a carrier] -- in addition -- and let what is made to discover the function of the ingredient of various plurality like functional separation of a laminated structure (it is hereafter described as "a functional manifestation") be a technical problem. Thereby, the life of a component makes it a technical problem to offer an organic long light emitting device in the top where driver voltage is lower than before.

[0025] moreover, the thing for which such an organic light emitting device is used -- the former -- driver voltage -- low -- in addition -- and let it be a technical problem to offer the long luminescence equipment of a life. furthermore, the thing for which an electric appliance is produced using said luminescence equipment -- the former -- a low power -- it is -- in addition -- and let it be a technical problem to offer the electric appliance which merit-maintains and is carried out.

[0026]

[Means for Solving the Problem] About relaxation of the energy barrier in a laminated structure, it sees on the technique of insertion of a carrier impregnation layer which is looked at by reference 5 notably. The explanation using an energy band diagram is shown in drawing 1 by making a hole injection layer into an example.

[0027] Although the anode plate 101 and the electron hole transportation layer 102 are directly joined in

drawing 1 (a), the energy barrier 104 of an anode plate 101 and the electron hole transportation layer 102 is large in this case. However, an energy barrier can be designed stair-like by inserting the ingredient which has the HOMO level located in the middle of the ionization potential of an anode plate, and the highest occupied molecular orbital (it is hereafter described as "HOMO") level of an electron hole transportation layer as a hole injection layer 103 (drawing 1 (b)).

[0028] By designing a stair-like energy barrier like drawing 1 (b), the carrier impregnation nature from an electrode can be raised and, to be sure, until can lower driver voltage to some extent. However, when a trouble increases the number of layers, the number of organic interfaces is increasing conversely. It is thought that the direction of monolayer structure is the cause of holding the top data of driver voltage and power effectiveness as this is shown by reference 4.

[0029] on the contrary -- if it says, while harnessing the merit (various ingredients can be combined and a complicated molecular design is unnecessary) of a laminated structure by conquering this point -- in addition -- and it can catch up with the driver voltage and power effectiveness of monolayer structure.

[0030] Then, in the organic compound film containing two or more (one or more kinds are a high molecular compound among those) kinds of organic compounds, this invention person abolished the interface in the parenchyma top organic compound film, and devised the technique of easing the energy barrier in the organic compound film.

[0031] Namely, the hole injectional compound with which the organic compound film receives an electron hole from said anode plate, The electron injectional compound, electron hole transportability compound which receive an electron from said cathode, The blocking nature compound which can prevent migration of an electronic transportability compound, an electron hole, or an electron, When it contains at least two compounds chosen from a group of luminescent compound ** which presents luminescence, it is the technique of abolishing the interface in the parenchyma top organic compound film by preparing the field (it being hereafter described as a "mixing zone") which the at least two compounds are mixing. Below, this technique is described as mixed junction.

[0032] In addition, in this invention, generally, the reason using a high molecular compound has large carrier mobility, and its direction of a high molecular compound is because it can drive on a low electrical potential difference. That is, in the system using a high molecular compound, it becomes the description of this invention to carry out mixed junction.

[0033] In this case, the hole injectional compound, the electron injectional compound, the electron hole transportability compound, and the electronic transportability compound may have the function which presents luminescence. Moreover, the luminescent compound may have carrier transportability and carrier impregnation nature, and may be the scarce ingredient of carrier transportability.

[0034] Moreover, as for a mixing zone, it is desirable to form in the location distant from an anode plate and cathode. As one reason, the field which can discover each function, such as carrier impregnation, carrier transportation, and luminescence, is making the interface in the organic compound film into a mixing zone, holding, and is for making an obstruction ease.

[0035] When it has the function of luminescence of a mixing zone especially, in order to keep away a mixing zone from an electrode and to prevent quenching (it is hereafter described as "quenching") by the electrode, it is necessary to separate from an electrode. In that case, it is desirable to separate 20nm or more of mixing zones from an electrode in consideration of diffusion of a molecule exciton. Extent of the distance to detach should just choose the most efficient distance in consideration of carrier balance.

[0036] By the way, when forming such mixed junction, the technique of doping a guest to a mixing zone is also considered. In a mixing zone, since it is thought that migration of a carrier is lubricous, it is desirable to use the luminescent compound which presents luminescence as a guest.

[0037] the organic light emitting device in which a functional manifestation is possible can be produced without showing a clear laminated structure by carrying out mixed junction which was described above (namely, a clear organic interface -- there being nothing).

[0038] Moreover, when preparing the mixing zone which said the first organic compound and said second organic compound are mixing into the organic compound film containing the first organic compound and the second organic compound with which said first organic compounds differ, the case where the first organic compound and second organic compound are [both] a high molecular compound, and one side may be low molecular weight compounds. Furthermore, in addition, the technique of giving a continuous concentration change in a mixing zone is desirable. Below, such technique will be described as "continuation junction." Moreover, especially the mixing zone in that case is described as a "continuation junction field."

[0039] The conventional laminated structure and the conceptual diagram of continuation junction of this invention are shown in drawing 2 . Drawing 2 (a) is the conventional laminated structure (it is terrorism structure to a single). That is, the laminated structure (or you may call it a clear organic interface) which has organic compound film 203a which consists of the first organic compound 201 and second organic compound 202, and is formed from first organic compound layer 201a and second organic compound layer 202a exists. In this case, it turns out that the field which changes gradually does not exist but the concentration of the first organic compound 201 and the concentration of the second organic compound 202 have become discontinuity (that is, in an organic interface, concentration is changing [% / 100] from 0% from change or 100% to 0%).

[0040] However, since the field (namely, continuation junction field 204b) where the concentration of the first organic compound 201 and the concentration of the second organic compound 202 are changing gradually exists in organic compound film 203b in continuation junction (drawing 2 (b)) of this invention, a clear organic interface does not exist. However, since it exists, the field (second functional area 202b) where the field (primary-function field 201b) where the first organic compound can discover a function, and the second organic compound can discover a function can discover the function of each ingredient.

[0041] the organic light emitting device in which a functional manifestation is possible can be produced without showing a clear laminated structure by carrying out continuation junction which was described above (namely, a clear organic interface -- there being nothing).

[0042] By the way, as for the first organic compound and second organic compound, it is desirable to have a different function from a viewpoint of the concept (that is, the function of the ingredient of various plurality is discovered, without using a laminated structure) of this invention.

[0043] In this case, if the first organic compound and second organic compound are [both] a high molecular compound, one side presents luminescence and the configuration whose another side discovers a carrier transportation function can be considered. Moreover, when the second organic compound is a low molecular weight compound, a low molecular weight compound presents luminescence and the configuration whose high molecular compound discovers a carrier transportation function, and the configuration in which a high molecular compound presents luminescence to and a low molecular weight compound discovers a carrier transportation function can be considered.

[0044] Furthermore, when a high molecular compound discovers a carrier transportation function, said high molecular compound is a high molecular compound (namely, conductive polymer compound) containing a pi electron, and it is desirable by performing chemistry doping to said high molecular compound further to raise conductivity.

[0045] In addition, as a high molecular compound used as an electron hole transportability compound, the poly thiophene derivative, the poly aniline derivative, a polyvinyl-carbazole derivative, etc. are desirable, and a polyphenylene derivative, a poly para-phenylene vinylene derivative, the poly dialkyl fluorene derivative, etc. are desirable as a high molecular compound used as a luminescent compound.

[0046] Moreover, in case mixed junction (continuation junction is included) which was described above is carried out, in a mixing zone, the technique of giving said guest's function can be considered by adding the third organic compound as a guest. It is desirable to make into a guest the luminescent compound which presents luminescence from a viewpoint of a functional manifestation. Because, it is because it is thought that the transportability or blocking nature of a carrier is given to the first organic compound and second organic compound which form a mixing zone, it is adding a luminescent compound to the mixing zone, the rate of recombination of a carrier is raised, and luminous efficiency becomes high.

[0047] The conceptual diagram is shown in drawing 3 (a). In drawing 3 (a), the organic compound film 303 which contains the first organic compound and second organic compound between an anode plate 302 and cathode 304 was formed on the substrate 301, the compound 306 which presents luminescence to the mixing zone 305 was added, and it considered as the luminescence field.

[0048] By the way, the energy which will be emitted in case it returns from a triplet excitation state to a ground state if it says in the viewpoint of luminous efficiency in recent years The organic light emitting device which can change (it is hereafter described as "triplet excitation energy") into luminescence It is observed by because of the high luminous efficiency (). [reference 7:D.] F.O'Brien and M.A.Baldo, M.E.Thompson and S. R.Forrest and "Improvedenergy transfer in electrophosphorescent devices", Applied Physics Letters, and vol. -- 74, No.3, and 442-444 (it TetsuoTSUTSUI(s) reference (1999) 8: --) Moon-Jae YANG and Masayuki YAHIRO and Kenji NAKAMURA, Teruichi WATANABE and Taishi

TSUJI and Yoshinori FUKUDA, Takeo WAKIMOTO and Satoshi MIYAGUCHI and "High Quantum Efficiency in Organic Light-Emitting Devices with Iridium-Complex as a Triplet Emissive Center", Japanese Journal of Applied Physics, Vol.38, and L1502-L1504 (1999).

[0049] By reference 7, the metal complex which uses iridium as a central metal for the metal complex which uses platinum as a central metal by reference 8 is used. The organic light emitting device (it is hereafter described as a "triplet light emitting device") which can change such triplet excitation energy into luminescence can attain high brightness luminescence and quantity luminous efficiency conventionally.

[0050] However, according to the example of a report of reference 8, the half-life of the brightness at the time of setting initial brightness as 500 cd/m2 is about 170 hours, and a problem is in a component life. Then, in addition to high brightness luminescence and quantity luminous efficiency by luminescence from a triplet excitation state, the very highly efficient light emitting device also of the life of a component of being long becomes possible by applying this invention to a triplet light emitting device.

[0051] Therefore, also when you choose the ingredient which can change triplet excitation energy into luminescence as the third organic compound which is a guest and you add to a mixing zone, suppose that it includes in this invention.

[0052] It is not necessary to restrict what is considered as the third organic compound to the luminescent compound which presents luminescence. When the first organic compound or second organic compound presents luminescence especially, compared with said the first organic compound and said second organic compound, it is desirable as the third organic compound to use a compound (namely, compound which can block a carrier and a molecule exciton) with the large energy difference of a highest occupied molecular orbital (HOMO) and a minimum sky molecular orbital (LUMO). It becomes possible to raise the rate of recombination of a carrier and to raise luminous efficiency by this technique, in the mixing zone formed with the first organic compound and second organic compound.

[0053] The conceptual diagram is shown in drawing 3 (b). In drawing 3 (b), the organic compound film 303 which contains the first organic compound and second organic compound between an anode plate 302 and cathode 304 was formed on the substrate 301, and the compound (blocking nature compound) 307 which can block a carrier and a molecule exciton to the concentration change field 305 was added.

[0054] In addition, in drawing 3 (b), the luminescence field which added the luminescent compound 306 which presents luminescence further is also prepared to the mixing zone 305. That is, it is the gestalt by which the technique (drawing 3 (a)) using the luminescent compound which presents luminescence as the third organic compound, and addition of a blocking nature compound were merged. What is necessary is here, as for the compound 307 which can block a carrier and a molecule exciton, just to use the thing of electron hole blocking nature, since the compound 307 which can block a carrier and a molecule exciton is in a cathode side rather than the luminescent compound 306 which presents luminescence.

[0055] As a compound which can block a carrier and a molecule exciton, a phenanthroline derivative, an OKISA diazole derivative, a triazole derivative, etc. can be considered.

[0056] By the way, when it pinpoints a mixing zone which was described above, it is thought that the elemental analysis by SIMS becomes an important technique. As shown also in the conceptual diagram shown by drawing 2 especially in continuation junction, it is thought that a remarkable difference appears compared with the conventional laminated structure.

[0057] Therefore, the amount of detection of said element detectable [with SIMS] among the elements which constitute the first organic compound or second organic compound shall include the luminescence equipment which has the field which changes from said anode plate continuously to the direction of said cathode in this invention.

[0058] Moreover, in order that the high molecular compound containing the 15th group element or the 16th group element may generally be well used for an organic light emitting device and may raise the conductivity of a high molecular compound, chemistry doping of the compound containing the 17th group element may be carried out. then, the ingredient containing the 15th group element thru/or the 17th group element and the ingredient which is not included -- since -- concentration change can be more notably observed by forming a continuation junction field. As the 15th group element thru/or the 17th group element, nitrogen, phosphorus, oxygen, sulfur, fluorine, chlorine, a bromine, iodine, etc. are in use.

[0059] Furthermore, when adding the third organic compound as a guest to a mixing zone, a metal complex may be used as the compound which serves as the guest, especially a luminescent compound

which presents luminescence.
[0060] Therefore, the third organic compound shall be a metal complex which has a metallic element, and the detection field of said metallic element detectable [with SIMS] shall also include the luminescence equipment which is a field (namely, mixing zone) containing both said first organic compound and said second organic compound in this invention. As a metallic element, aluminum, zinc, or beryllium is in use. Moreover, since the metal complex which uses iridium and platinum as a central metal is in use when the third organic compound is a luminescent compound which presents luminescence from a triplet excitation state, iridium and platinum are detectable.
[0061] carrying out above this inventions -- the former -- driver voltage -- low -- in addition -- and the long luminescence equipment of a life can be offered. furthermore, the thing for which an electric appliance is produced using said luminescence equipment -- the former -- a low power -- it is -- in addition -- and the electric appliance which merit-maintains and is carried out can be offered.
[0062]
[Embodiment of the Invention] Below, the gestalt at the time of carrying out this invention is described. In addition, although it is good if either an anode plate or the cathode of the organic light emitting device is transparent at least in order to take out luminescence, in the gestalt of this operation, it forms a transparent anode plate on a substrate, and describes it with the component structure which takes out light from an anode plate. In practice, the structure which takes out light from cathode, and the structure which takes out light from a reverse side with a substrate are also applicable to this invention.
[0063] In carrying out this invention, the production process which forms a mixing zone or a continuation junction field becomes important. this invention person devised the process which forms a mixing zone or a continuation junction field in the organic compound film containing a high molecular compound. Then, the manufacture approach of the organic light emitting device indicated by this invention here is described.
[0064] At the conventional process, the first solution which the first organic compound dissolved, for example is applied (when it constitutes a laminated structure from wet spreading), and after removing completely the solvent contained in said first solution by heating etc., in order to form the second organic compound which dissolved in the solution with which the first organic compound is not eluted, a clear organic interface will be produced.
[0065] For example, the water solution of the polyethylene dioxythiophene (it is hereafter described as "PEDOT") which doped polystyrene sulfonate (it is hereafter described as "PSS") is formed by spin coating, and after heat-treating above 100 degrees C and removing water completely under atmospheric pressure, the cross-section TEM photograph of the organic compound film which formed membranes by spin coating and carried out stoving of the toluene solution of the poly para-phenylene vinylene (it is hereafter described as "PPV") which has an alkoxyl group again is shown in drawing 4 . At the conventional process, it becomes the laminated structure which produces a clear organic interface so that clearly from drawing 4 .
[0066] Solving this, this invention person devised the five manufacture approaches as a process which forms a mixing zone or a concentration change field. Below, it describes about the case of the organic compound film which contains two kinds of organic compounds which are the easiest examples about the gestalt of the operation.
[0067] The first manufacture approach is shown in drawing 5 . First, wet spreading of the first solution 503a which the first organic compound (high molecular compound) dissolved on the substrate 501 (drawing 5 (a)) which formed the electrode 502 is carried out (drawing 5 (b)). Next, it heats at the temperature from which the vapor pressure of the solvent contained in the first solution turns into below the atmospheric pressure of an activity ambient atmosphere as a process 511 which forms a mixing zone or a continuation junction field (drawing 5 (c)), and wet spreading of the second solution 504 which the second organic compound dissolved in condition 503b in which the solvent contained in the first solution remained is carried out (drawing 5 (d)). Finally, heating 512 removes all solvents and the organic compound film of this invention which has a mixing zone or the continuation junction field 505 is obtained.
[0068] Next, the second manufacture approach is shown in drawing 6 . First, wet spreading of the first solution 603a which the first organic compound (high molecular compound) dissolved on the substrate 601 which formed the electrode 602 is carried out (drawing 6 (a)). Next, first organic compound film 603b is formed by removing completely the solvent contained in first solution 603a by heating 611 (drawing 6 (b)). Furthermore, wet spreading of the second solution 604 which formed elution field 603c

by putting on the condition that the solvent contained in the first solution is contained in an activity ambient atmosphere as a process 612 which forms a mixing zone or a continuation junction field (drawing 6 (c)), and the second organic compound dissolved after that is carried out (drawing 6 (d)). Finally, heating 613 removes all solvents and the organic compound film of this invention which has a mixing zone or the continuation junction field 605 is obtained.

[0069] Moreover, a mixing zone or a continuation junction field can be formed as the third manufacture approach using the low molecular weight compound which can carry out dry type membrane formation as the first organic compound. That is, after forming first organic compound film 603b with a vacuum deposition method etc. (that is, condition of drawing 6 (b)), it is the technique of carrying out wet spreading of the second organic compound (high molecular compound) which melted the first organic compound to the solvent which can dissolve slightly, and forming the condition of drawing 6 (d).

[0070] Furthermore, although it is the fourth manufacture approach, in drawing 6 , a low molecular weight compound can also be used as the first organic compound. That is, it is the technique (drawing 6 (c)) of forming first organic compound film 603b with a vacuum deposition method etc. first, forming the condition of drawing 6 (b), and forming elution field 603c by putting on the condition that the solvent which can dissolve the first organic compound is contained in an activity ambient atmosphere.

[0071] By the way, all of the first process described in the top - the fourth process consist of polymeric materials in which the second organic compound carries out wet spreading. this invention person also devised the technique of forming a mixing zone or a continuation junction field, after carrying out wet spreading of the polymeric materials as the first organic compound previously and carrying out vacuum deposition of the low molecular weight compound as the second organic compound as the fifth manufacturing method contrary to it.

[0072] The fifth technique is the technique of conveying in a vacuum tub, forming the second organic compound (low molecular weight compound) with vacuum deposition subsequently, making diffuse the second organic compound (low molecular weight compound) by [the] carrying out afterbaking, and forming a mixing zone or a concentration change field, after carrying out wet spreading of the solution which dissolved the first organic compound (high molecular compound) to the substrate which has an electrode. Whenever [stoving temperature] should just be the temperature which the solvent which said first organic compound is dissolving can remove completely.

[0073] In the fifth technique, the technique of performing heating to the bottom of reduced pressure of 10 - 4 pascals is still more desirable. In this case, whenever [stoving temperature] has 60 degrees C - desirable about 100 degrees C.

[0074] About the wet applying method which was described above, various technique is possible and the others and mutual adsorption process and ink jet method which are generally used can be considered. [methods /, such as spin coating and DIP coating, / wet forming-membranes] It is thought that especially an ink jet method is technique effective in case a high definition and large area luminescence equipment are created since it is also possible to cross an organic compound to the large range and it to carry out patterning possible [carrying out patterning with high precision].

[0075] The conceptual diagram which realizes said first manufacture approach with an ink jet method is shown in drawing 7 . First, the bank structure 706 is formed with a photolithography technique on the substrate 701 (drawing 7 (a)) which has an electrode 702 (drawing 7 (b)). Next, wet spreading of the first solution 703a which the first organic compound (high molecular compound) dissolved is carried out by ink jet printer head 721a (drawing 7 (c)). furthermore, as a process 711 which forms a mixing zone or a continuation junction field It heats at temperature lower than the temperature from which the vapor pressure of the solvent contained in first solution 703a turns into an atmospheric pressure of an activity ambient atmosphere (drawing 7 (d)). Wet spreading of the second solution 704 which the second organic compound dissolved in condition 703b in which the solvent contained in the first solution remained is carried out by ink jet printer head 721b (drawing 7 (e)). Finally, heating removes all solvents and the organic compound film of this invention which has a mixing zone or a continuation junction field is obtained.

[0076] For example, when using the compound which presents luminescence as the second organic compound, full color luminescence equipment can be produced by distinguishing each pixels 707a-707c by different color for red, green, and the compound that presents the color of each blue with using ink jet printer head 721b.

[0077] By the manufacture approach which was described above, the mixing zone or continuation junction field indicated by this invention can be formed.

[0078]
[Example] In [example 1] this example, the organic light emitting device produced by applying the technique shown in drawing 5 in the gestalt of implementation of invention is illustrated concretely.
[0079] First, on a glass substrate, by sputtering, about 100nm forms membranes and let an indium stannic acid ghost (it is hereafter described as "ITO") be an anode plate. Next, the water solution of PEDOT which doped PSS as an ingredient of electron hole transportability is formed on said anode plate by spin coating.
[0080] Here, as drawing 5 showed, said substrate is heated at temperature lower than the temperature (100 degrees C) from which the vapor pressure of water turns into atmospheric pressure, and it considers as the condition that the moisture of a PEDOT water solution remained slightly. Furthermore, the alkoxyl group permutation PPV (it is hereafter described as "MEH-PPV") which uses toluene as a solvent is formed by spin coating, and a solvent is completely removed by heating at 100 degrees C or more.
[0081] Finally, 400nm of ytterbiums is vapor-deposited with vacuum deposition as cathode, and the organic light emitting device of this invention which presents green luminescence originating in MEH-PPV is obtained.
[0082] In [example 2] this example, the organic light emitting device produced by applying the technique shown by drawing 6 in the gestalt of implementation of invention is illustrated concretely.
[0083] First, on a glass substrate 601, by sputtering, about 100nm forms membranes and let ITO be an anode plate 602. Next, a solvent (moisture) is completely removed by forming membranes on said anode plate and heating the water solution of PEDOT which doped PSS as an ingredient of electron hole transportability for 10 minutes at 150 degrees C by spin coating.
[0084] Here, as drawing 6 showed, water and a xylene are completely removed by forming the poly dioctyl fluorene (it being hereafter described as "PDOF") which uses a xylene as a solvent under the ambient atmosphere containing a steam by spin coating, and heating at 100 degrees C or more after that.
[0085] The organic light emitting device of this invention which finally presents as cathode blue luminescence which subsequently vapor-deposits 100nm of 150nm of aluminum with vacuum deposition, and originates calcium in PDOF is obtained.
[0086] In [example 3] this example, after forming a low molecular weight compound with vacuum deposition, the organic light emitting device produced by applying the technique of applying the high molecular compound melted into the solvent which the low molecular weight compound dissolves slightly is illustrated concretely.
[0087] First, on a glass substrate, by sputtering, about 100nm forms membranes and let an indium stannic acid ghost (it is hereafter described as "ITO") be an anode plate. Next, 4, 4', and a 4"-tris [N-(3-methylphenyl)-N-phenylamino]-triphenylamine (it is hereafter described as "MTDATA") are formed with vacuum deposition on said anode plate as an ingredient of electron hole transportability.
[0088] Here, the solution which dissolved the PPV precursor meltable to a polar solvent in ethanol is formed by spin coating. By heating at 80 degrees C or more after that, the polymerization of the PPV is carried out at the same time it removes a solvent completely.
[0089] Finally, 400nm of ytterbiums is vapor-deposited with vacuum deposition as cathode, and the organic light emitting device of this invention which presents green luminescence originating in PPV is obtained.
[0090] In [example 4] this example, the organic light emitting device produced by applying the technique of an ink jet method is illustrated concretely.
[0091] First, on a glass substrate 701, ITO702 [about 100nm] is formed by sputtering, and the bank structure 706 is further formed with a photolithography technique (drawing 7 (b)). Next, a solvent (moisture) is completely removed by forming membranes on said anode plate by ink jet printer head 721a, and heating water-solution 703a of PEDOT which doped PSS as an ingredient of electron hole transportability for 10 minutes at 150 degrees C. Thus, formed PEDOT703a becomes extent which stops being able to melt into water easily and is eluted slightly.
[0092] Water and a xylene are completely removed by forming membranes by ink jet printer head 721b, and heating after that the ink using the water solution 704 which dissolved the further water-soluble PPV precursor at 100 degrees C or more here.
[0093] The organic light emitting device of this invention which finally presents as cathode green luminescence which subsequently vapor-deposits 100nm of 150nm of aluminum with vacuum deposition, and originates calcium in PPV is obtained.

[0094] After carrying out wet spreading of the solution which dissolved the 1st organic compound (high molecular compound) in [example 5] this example to the substrate which has an electrode, By conveying in a vacuum tub, forming the 2nd organic compound (low molecular weight compound) with vacuum deposition subsequently, diffusing the 2nd organic compound (low molecular weight compound) by [the] carrying out afterbaking, and forming a mixing zone or a continuation junction field The example which produces the organic light emitting device by which the compound (compound which presents luminescence from a triplet excitation state here) which presents luminescence to the mixing zone or a continuation junction field was doped is illustrated concretely. At this time, whenever [stoving temperature] should just be the temperature which the solvent which said 1st organic compound is dissolving can remove completely. Furthermore, it is more desirable when heating is performed to the bottom of reduced pressure of about 10 - 4 pascals.

[0095] First, on a glass substrate, by sputtering, about 100nm forms membranes and let an indium stannic acid ghost (it is hereafter described as "ITO") be an anode plate. Next, as an ingredient of electron hole transportability, in order to use a polyvinyl carbazole (it is hereafter described as "PVK"), the chloroform solution of PVK is formed by spin coating, and heating removes a solvent. Then, since the solution using the same solvent (chloroform) is coated, in order to enlarge thickness to some extent, it is desirable [this membrane formation] to carry out several times.

[0096] next, the bis(2-phenyl pyridine)-acetylacetonate iridium (it is hereafter described as "Ir (ppy)2 (acac)") complex which is triplet luminescent material at the chloroform solution of PVK -- 5wt(s)% -- the added solution is prepared and membranes are formed by spin coating on the PVK film which formed membranes previously.

[0097] Here, vacuum deposition of the tris (8-quinolinolato) aluminum (it is hereafter described as "Alq3") which is an electronic transportation ingredient is carried out to the bottom of reduced pressure of 10 - 3 pascals, without heating a substrate. Then, the field (field which doped Ir(ppy) 2 (acac) to the mixing zone of PVK and Alq3) which made Ir (ppy)2 (acac) the guest by making PVK and Alq3 into a host can be formed by BEKU [80 degrees C] under reduced pressure of 10 - 4 pascals.

[0098] Finally, 150nm of aluminum:Li alloys is vapor-deposited with vacuum deposition as cathode, and the organic light emitting device of this invention which presents green luminescence originating in Ir (ppy)2 (acac) is obtained.

[0099] [Example 6] this example explains the luminescence equipment containing the organic light emitting device indicated by this invention. Drawing 8 is the sectional view of the active-matrix mold luminescence equipment which used the organic light emitting device of this invention. In addition, an MOS transistor may be used although the thin film transistor (it is hereafter described as "TFT") is used as an active element here.

[0100] Moreover, although the top gate mold TFT (specifically planar mold TFT) is illustrated as TFT, the bottom gate mold TFT (typically reverse stagger mold TFT) can also be used.

[0101] In drawing 8 , 801 is a substrate and uses the substrate which penetrates the light here. What is necessary is just to specifically use a glass substrate, a quartz substrate, a crystallization glass substrate, or a plastic plate (for plastic film to be included). In addition, the insulator layer prepared in the front face shall also be included in a substrate 801.

[0102] On the substrate 801, the picture element part 811 and the drive circuit 812 are formed. First, a picture element part 811 is explained.

[0103] A picture element part 811 is a field which performs image display. Two or more pixels exist on a substrate, and TFT(it is hereafter described as "the current control TFT") 802, the pixel electrode (anode plate) 803, the organic compound film 804, and cathode 805 for controlling the current which flows to an organic light emitting device are established in each pixel. In addition, although only the current control TFT is illustrated in drawing 8 , TFT (it is hereafter described as "Switching TFT") for controlling the electrical potential difference which joins the gate of the current control TFT is prepared.

[0104] As for the current control TFT802, it is desirable to use the p channel mold TFT here. Although considering as the n channel mold TFT is also possible, when connecting the current control TFT to the anode plate of an organic light emitting device like drawing 8 , the p channel mold TFT can press down power consumption. However, the n channel mold TFT or the p channel mold TFT may be used for Switching TFT.

[0105] Moreover, the pixel electrode 803 is electrically connected to the drain of the current control TFT802. In this example, in order to use the conductive ingredient whose work function is 4.5-5.5eV as an ingredient of the pixel electrode 803, the pixel electrode 803 functions as an anode plate of an organic

light emitting device. What is necessary is just to use indium oxide, tin oxide, zinc oxides, or these compounds (ITO etc.) typically as a pixel electrode 803. The organic compound layer 804 is formed on the pixel electrode 803.

[0106] Furthermore, cathode 805 is formed on the organic compound layer 804. It is desirable to use the conductive ingredient whose work function is 2.5-3.5eV as an ingredient of cathode 805. What is necessary is just to use typically the electric conduction film containing alkali metals or an alkalinity metallic element, the electric conduction film containing aluminum, or the thing that carried out the laminating of aluminum, the silver, etc. to the electric conduction film as cathode 805.

[0107] Moreover, the pixel electrode 803, the organic compound layer 804, and the layer that consists of cathode 805 are covered by the protective coat 806. The protective coat 806 is formed in order to protect an organic light emitting device from oxygen and water. As an ingredient of a protective coat 806, silicon nitride, nitriding oxidation silicon, an aluminum oxide, tantalum oxide, or carbon (specifically diamond-like carbon) is used.

[0108] Next, the drive circuit 812 is explained. The drive circuit 812 is a field which controls the timing of the signal (a gate signal and data signal) transmitted to a picture element part 811, and a shift register, the buffer, the latch, the analog switch (transfer gate), or the level shifter is prepared. Drawing 8 shows the CMOS circuit which consists of an n channel mold TFT807 and a p channel mold TFT808 as a base unit of these circuits.

[0109] In addition, it is easy to be well-known [the circuitry of a shift register, a buffer, a latch, an analog switch (transfer gate), or a level shifter]. Moreover, although the picture element part 811 and the drive circuit 812 are formed on the same substrate in drawing 8 , IC and LSI can also be connected electrically, without forming the drive circuit 812.

[0110] Moreover, although the pixel electrode (anode plate) 803 is electrically connected to the current control TFT802 in drawing 8 , the structure where cathode was connected to the current control TFT can also be taken. In that case, what is necessary is to form a pixel electrode with the same ingredient as cathode 805, and just to form cathode with the same ingredient as the pixel electrode (anode plate) 803. In that case, as for the current control TFT, considering as the n channel mold TFT is desirable.

[0111] By the way, although what was produced at the process which forms wiring 809 is shown after the luminescence equipment shown in drawing 8 forms the pixel electrode 803, the pixel electrode 803 may start a surface dry area in this case. Since an organic light emitting device is a component of a current drive mold, it is also considered by the surface dry area of the pixel electrode 803 that a property worsens.

[0112] Then, as shown in drawing 9 , after forming wiring 909, the luminescence equipment which forms the pixel electrode 903 is also considered. In this case, compared with the structure of drawing 8 , it is thought that the impregnation nature of the current from the pixel electrode 903 improves.

[0113] Moreover, in drawing 8 and drawing 9 , each pixel currently installed in picture element parts 811 or 911 according to the bank-like structures 810 or 910 of a forward taper mold is separated. The structure where bank-like structure does not touch a pixel electrode can also be taken by making this bank-like structure into structure like for example, an inverse tapered shape mold. The example is shown in drawing 10 .

[0114] In drawing 10 , wiring and the separation section 1010 which served as the separation section using wiring were prepared. The configuration (structure with a canopy top) of wiring as shown by drawing 10 , and the separation section 1010 can be formed by carrying out the laminating of the metal which constitutes wiring, and the ingredient with a dirty rate lower than said metal (for example, metal nitride), and etching them. With this configuration, the pixel electrode 1003, and wiring and cathode 1005 can prevent short-circuiting. In addition, unlike the luminescence equipment of the usual active-matrix mold, in drawing 10 , it becomes the structure which makes cathode 1005 on a pixel the shape of a stripe (passive matrix is the same as that of cathode).

[0115] Here, the appearance of the active-matrix mold luminescence equipment shown in drawing 9 is shown in drawing 11 . In addition, a plan is shown in drawing 11 (a) and the sectional view when cutting drawing 11 (a) by P-P' is shown in drawing 11 (b). Moreover, the sign of drawing 9 is quoted.

[0116] As for a picture element part and 1102, in drawing 11 (a), 1101 is [a gate signal side drive circuit and 1103] data signal side drive circuits. Moreover, the signal transmitted to the gate signal side drive circuit 1102 and the data signal side drive circuit 1103 is inputted from the TAB (Tape Automated Bonding) tape 1105 through the input wiring 1104. In addition, although not illustrated, TCP (Tape Carrier Package) which prepared IC (integrated circuit) may be connected to a TAB tape instead of the

TAB tape 1105.

[0117] At this time, 1106 is covering material prepared above the organic light emitting device shown in drawing 9 , and is pasted up by the sealant 1107 which consists of resin. As long as the covering material 1106 is the quality of the material which does not penetrate oxygen and water, it may use what kind of thing. In this example, the covering material 1106 consists of carbon films (specifically diamond-like carbon film) 1106b and 1106c prepared in the front face and rear face of plastics material 1106a and said plastics material 1106a, as shown in drawing 11 (b).

[0118] Furthermore, as shown in drawing 11 (b), a sealant 1107 is covered with the sealing agent 1108 which consists of resin, and encloses an organic light emitting device with a closed space 1109 completely. A closed space 1109 should just be filled up with inert gas (typically nitrogen gas and rare gas), resin, or an inactive liquid (for example, liquefied fluorination carbon represented by the perfluoro alkane). Furthermore, it is also effective to form a desiccant and a deoxidant.

[0119] Moreover, a polarizing plate may be prepared in the screen (field which observes an image) of the luminescence equipment shown in this example. This polarizing plate presses down the reflection of light which carried out incidence from the outside, and has the effectiveness which prevents a watcher being reflected in the screen. Generally, the circular polarization of light plate is used. However, in order to prevent being reflected by the polarizing plate and the light emitted from the organic compound layer returning to the interior, it is desirable to adjust a refractive index and to consider as structure with little internal reflection.

[0120] In addition, any of the organic light emitting device indicated by this invention may be used for the organic light emitting device contained in the luminescence equipment of this example.

[0121] By [example 7] this example, as an example of the luminescence equipment containing the organic light emitting device indicated by this invention, although active-matrix mold luminescence equipment is illustrated, in an example 6, it differs and the substrate in which the active element is formed shows the luminescence equipment of the structure (it is hereafter described as "upper part outgoing radiation") which takes out light from the opposite side. The sectional view is shown in drawing 19 .

[0122] In addition, an MOS transistor may be used although the thin film transistor (it is hereafter described as "TFT") is used as an active element here. Moreover, although the top gate mold TFT (specifically planar mold TFT) is illustrated as TFT, the bottom gate mold TFT (typically reverse stagger mold TFT) can also be used.

[0123] In this example, it is good with the same configuration as an example 6 about the current control TFT1902 formed in the substrate 1901 and the picture element part, and the drive circuit 1912.

[0124] Although it is the first electrode 1903 connected to the drain of the current control TFT1902, in order to use as an anode plate, in this example, it is desirable to use a conductive ingredient with a larger work function. As the example of representation, metals, such as nickel, palladium, a tungsten, gold, and silver, are mentioned. Although it is desirable in this example not to penetrate light as for the first electrode 1903, it is still more desirable to use the high ingredient of the reflexibility of light in addition to it.

[0125] The organic compound layer 1904 is formed on the first electrode 1903. Furthermore, the second electrode 1905 is formed on the organic compound layer 1904, and it considers as cathode in this example. In that case, it is desirable to use the conductive ingredient whose work function is 2.5-3.5eV as an ingredient of the second electrode 1905. What is necessary is typically, just to use the electric conduction film containing alkali metals or an alkalinity metallic element, the electric conduction film containing aluminum, or the thing that carried out the laminating of aluminum, the silver, etc. to the electric conduction film. However, since this example is upper part outgoing radiation, it is a major premise that the second electrode 1905 is light transmission nature. Therefore, when using these metals, it is desirable that it is an about 20nm super-thin film.

[0126] Moreover, the first electrode 1903, the organic compound layer 1904, and the layer that consists of the second electrode 1905 are covered by the protective coat 1906. The protective coat 1906 is formed in order to protect an organic light emitting device from oxygen and water. In this example, as long as it penetrates light, what kind of thing may be used.

[0127] In addition, although the first electrode (anode plate) 1903 is electrically connected to the current control TFT1902 in drawing 19 , the structure where cathode was connected to the current control TFT can also be taken. In that case, what is necessary is to form the first electrode with the ingredient of cathode and just to form the second electrode with the ingredient of an anode plate. As for the current

control TFT, at this time, considering as the n channel mold TFT is desirable.
[0128] Furthermore, 1907 is covering material and is pasted up by the sealant 1908 which consists of resin. As long as the covering material 1907 is the quality of the material which does not penetrate oxygen and water and is the quality of the material which penetrates light, it may use what kind of thing. Glass is used in this example. A closed space 1909 should just be filled up with inert gas (typically nitrogen gas and rare gas), resin, or an inactive liquid (for example, liquefied fluorination carbon represented by the perfluoro alkane). Furthermore, it is also effective to form a desiccant and a deoxidant.
[0129] In addition, the signal transmitted to a gate signal side drive circuit and a data signal side drive circuit is inputted from the TAB (Tape Automated Bonding) tape 1914 through the input wiring 1913. In addition, although not illustrated, TCP (Tape Carrier Package) which prepared IC (integrated circuit) may be connected to a TAB tape instead of the TAB tape 1414.
[0130] Moreover, a polarizing plate may be prepared in the screen (field which observes an image) of the luminescence equipment shown in this example. This polarizing plate presses down the reflection of light which carried out incidence from the outside, and has the effectiveness which prevents a watcher being reflected in the screen. Generally, the circular polarization of light plate is used. However, in order to prevent being reflected by the polarizing plate and the light emitted from the organic compound layer returning to the interior, it is desirable to adjust a refractive index and to consider as structure with little internal reflection.
[0131] In addition, any of the organic light emitting device indicated by this invention may be used for the organic light emitting device contained in the luminescence equipment of this example.
[0132] In [example 8] this example, passive matrix mold luminescence equipment is illustrated as an example of the luminescence equipment containing the organic light emitting device indicated by this invention. The plan is shown in drawing 12 (a), and the sectional view when cutting drawing 12 (a) by P-P' is shown in drawing 12 (b).
[0133] In drawing 12 (a), 1201 is a substrate and uses plastics material here. As plastics material, what carried out polyimide, a polyamide, acrylic resin, an epoxy resin, PES (polyether sulphone), PC (polycarbonate) and PET (polyethylene terephthalate), or PEN (polyether nitril) on tabular or a film can be used.
[0134] 1202 is the scanning line (anode plate) which consists of oxidation electric conduction film, and uses the oxide electric conduction film which added the oxidation gallium to the zinc oxide in this example. Moreover, 1203 is the data line (cathode) which consists of a metal membrane, and uses the bismuth film in this example. Moreover, 1204 is a bank which consists of acrylic resin, and functions as a septum for dividing the data line 1203. Both the scanning line 1202 and the data line 1203 are formed so that two or more formation may be carried out and it may intersect perpendicularly with the shape of a stripe mutually. In addition, although not illustrated in drawing 12 (a), the organic compound layer is pinched between the scanning line 1202 and the data line 1203, and an intersection 1205 serves as a pixel.
[0135] And the scanning line 1202 and the data line 1203 are connected to an external drive circuit through the TAB tape 1207. In addition, 1208 expresses the wiring group in which the scanning line 1202 comes to gather, and 1209 expresses the wiring group which consists of a set of the connection wiring 1206 connected to the data line 1203. Moreover, although not illustrated, TCP which prepared IC may be connected to a TAB tape instead of the TAB tape 1207.
[0136] Moreover, in drawing 12 (b), it is the covering material by which 1210 was stuck on the sealant by the sealant 1210 and 1211 was stuck on the plastics material 1201. There is little degasifying and a hygroscopic low ingredient is [that what is necessary is just to use photo-curing resin as a sealant 1210] desirable. The ingredient same as covering material as a substrate 1201 is desirable, and glass (quartz glass is included) or plastics can be used. Here, plastics material is used.
[0137] Next, the enlarged drawing of the structure of a pixel field is shown in drawing 12 (c). 1213 is an organic compound layer. In addition, as shown in drawing 12 (c), lower layer width of face is a narrow configuration from the upper width of face, and bank 1204 can divide the data line 1203 physically. Moreover, the picture element part 1214 surrounded by the sealant 1210 is intercepted from the open air with the sealing agent 1215 which consists of resin, and has structure which prevents degradation of an organic compound layer.
[0138] Since a picture element part 1214 is formed in the scanning line 1202, the data line 1203, bank 1204, and the organic compound layer 1213, the luminescence equipment of this invention which

consists of the above configurations is producible in a very easy process.
[0139] Moreover, a polarizing plate may be prepared in the screen (field which observes an image) of the luminescence equipment shown in this example. This polarizing plate presses down the reflection of light which carried out incidence from the outside, and has the effectiveness which prevents a watcher being reflected in the screen. Generally, the circular polarization of light plate is used. However, in order to prevent being reflected by the polarizing plate and the light emitted from the organic compound layer returning to the interior, it is desirable to adjust a refractive index and to consider as structure with little internal reflection.
[0140] In addition, any of the organic light emitting device indicated by this invention may be used for the organic light emitting device contained in the luminescence equipment of this example.
[0141] [Example 9] this example shows the example which prepared and carried out the modularization of the printed wired board to the luminescence equipment shown in the example 8.
[0142] The TAB tape 1304 is attached in a substrate 1301 (here, a picture element part 1302, wiring 1303a, and 1303b are included), and, as for the module shown in drawing 13 (a), the printed wired board 1305 is attached through said TAB tape 1304.
[0143] Here, the functional block diagram of a printed wired board 1305 is shown in drawing 13 (b). IC which functions at least as I/O Port (an input or output section) 1306, 1309, the data signal side drive circuit 1307, and a gate signal side circuit 1308 is prepared in the interior of a printed wired board 1305.
[0144] Thus, the module of a configuration of that the TAB tape was attached in the substrate with which the picture element part was formed in the substrate side, and the printed-circuit version which has a function as a drive circuit through the TAB tape was attached is made to call it a drive circuit external mold module especially on these specifications.
[0145] In addition, any of the organic light emitting device indicated by this invention may be used for the organic light emitting device contained in the luminescence equipment of this example.
[0146] [Example 10] this example shows the example which prepared and carried out the modularization of the printed wired board to the luminescence equipment shown in the example 6, the example 7, or the example 8.
[0147] The TAB tape 1405 is attached in a substrate 1401 (here, a picture element part 1402, the data signal side drive circuit 1403, the gate signal side drive circuit 1404, wiring 1403a, and 1404a are included), and, as for the module shown in drawing 14 (a), the printed wired board 1406 is attached through the TAB tape 1405. The functional block diagram of a printed wired board 1406 is shown in drawing 14 (b).
[0148] As shown in drawing 14 (b), IC which functions as I/O Port 1407, 1410, and the control section 1408 at least is prepared in the interior of a printed wired board 1406. In addition, although the memory section 1409 is formed here, it is not necessarily required. Moreover, the control section 1408 is a part with the function for controlling control of a drive circuit, amendment of image data, etc.
[0149] Thus, the module of a configuration of that the printed wired board which has a function as a controller in the substrate with which the organic light emitting device was formed was attached is made to call it a controller external mold module especially on these specifications.
[0150] In addition, any of the organic light emitting device indicated by this invention may be used for the organic light emitting device contained in the luminescence equipment of this example.
[0151] [Example 11] this example shows the example of the luminescence equipment which drives the organic light emitting device indicated by this invention in a constant voltage by digital time amount gradation display.
[0152] The circuitry of the pixel using an organic light emitting device is shown in drawing 17 (a). Tr expresses a transistor and Cs expresses a storage capacitor. In the circuitry in drawing 17 (a), the gate line is connected to the source side of a transistor Tr1 for the source line at the gate of a transistor Tr1. Moreover, the current supply line is connected to the storage capacitor Cs and source side of a transistor Tr2. Since the anode plate of the organic light emitting device of this invention is connected to the drain side of a transistor Tr2, on both sides of the organic light emitting device, the opposite side of a transistor Tr2 serves as cathode.
[0153] In this circuit, if a gate line is chosen, a current will flow from a source line to Tr1, and the electrical potential difference corresponding to that signal will be accumulated in Cs. And the current controlled by the gate of Tr2 and the electrical potential difference (Vgs) between the sources will flow to Tr2 and an organic light emitting device.
[0154] After Tr1 is chosen, Tr1 will be in an OFF state and the electrical potential difference (Vgs) of Cs

is held. Therefore, passing only the current depending on Vgs can be continued.
[0155] The chart which drives such a circuit by digital time amount gradation display is shown in drawing 17 (b). That is, although one frame was divided into two or more subframes, in drawing 17 (b), it considered as the 6-bit gradation which divides one frame into six subframes (SF1-SF6). TA is write-in time amount. In this case, the rate of each subframe luminescence period is set to 32:16:8:4:2:1 as shown in drawing.
[0156] The outline of the drive circuit of the TFT substrate in this example is shown in drawing 17 (c). With the substrate configuration in drawing 17 (c), a current supply line and cathode as the organic light emitting device of this invention shown by drawing 17 (a) to the picture element part made into each pixel are connected. Moreover, a shift register is the order of a shift register -> latch 1 -> latch 2 -> picture element part, and is connected to the picture element part. Image data is sendable into a picture element part with the latch pulse which a digital signal is inputted into latch 1 and inputted into latch 2.
[0157] The gate driver and the source driver are prepared on the same substrate, and a pixel circuit and a driver can obtain a uniform image, without being influenced of dispersion in a TFT property, since it is designed so that a digital drive may be carried out.
[0158] [Example 12] this example shows the example of the constant current drive circuit of the active-matrix mold driven by passing a fixed current to the organic light emitting device indicated by this invention. The circuitry is shown in drawing 18 .
[0159] The pixel 1810 shown in drawing 18 has a signal line Si, the 1st scanning line Gj, the 2nd scanning line Pj, and the power-source line Vi. Moreover, the pixel 1810 has the organic light emitting device 1811 and retention volume 1812 of Tr1, Tr2, Tr3, Tr4, and a mixed assembling die.
[0160] Both the gates of Tr3 and Tr4 are connected to the 1st scanning line Gj. One side is connected to a signal line Si, and another side is connected to the source of Tr2 for the source and the drain of Tr3. Moreover, one side is connected to the source of Tr2, and another side is connected to the gate of Tr1 for the source and the drain of Tr4. That is, the source of Tr3, either of the drains, and the source of Tr4 and either of the drains are connected.
[0161] The source of Tr1 is connected to the power-source line Vi, and the drain is connected to the source of Tr2. The gate of Tr2 is connected to the 2nd scanning line Pj. And the drain of Tr2 is connected to the pixel electrode which the organic light emitting device 1811 has. The organic light emitting device 1811 has the organic luminous layer prepared between the pixel electrode, the counterelectrode, and a pixel electrode and a counterelectrode. The fixed electrical potential difference is given according to the power source with which the counterelectrode of the organic light emitting device 1811 was prepared in the exterior of a luminescence panel.
[0162] In addition, either the n channel mold TFT or the p channel mold TFT is OK as Tr3 and Tr4. However, the polarity of Tr3 and Tr4 is the same. Moreover, either the n channel mold TFT or the p channel mold TFT is OK as Tr1. Either the n channel mold TFT or the p channel mold TFT is OK as Tr2. One side is an anode plate and another side of the pixel electrode and counterelectrode of a light emitting device is cathode. When Tr2 is the p channel mold TFT, it is desirable to use cathode as a counterelectrode, using an anode plate as a pixel electrode. On the contrary, when Tr2 is the n channel mold TFT, it is desirable to use an anode plate as a counterelectrode, using cathode as a pixel electrode.
[0163] Retention volume 1812 is formed between the gate of Tr1, and the source. Although it is prepared in order to maintain more certainly the gate of Tr1, and the electrical potential difference (VGS) between the sources, it is not necessary to necessarily form retention volume 1812.
[0164] In the current source in which a signal-line drive circuit has the current supplied to a signal line Si, it is controlled by the pixel shown in drawing 18 .
[0165] By applying the above circuitry, the constant current drive which is going to pass a fixed current to an organic light emitting device, and is going to keep brightness constant to it is attained. Although the organic light emitting device which has the mixing zone indicated by this invention has a long life compared with the conventional organic light emitting device, since reinforcement can be further attained by carrying out the above constant current drives, it is effective.
[0166] The luminescence equipment of this invention stated in the [example 13] above-mentioned example has the advantage that a life is long, with a low power. therefore, power consumption with the electric appliance lower than before with which said luminescence equipment is contained as a display etc. -- actuation -- possible -- in addition -- and it becomes the electric appliance which merit-maintains and is carried out. Since low-power-ization links with facilities directly about an electric appliance like the pocket device which uses a dc-battery especially as a power source (a cell piece cannot happen

easily), it is very useful.
[0167] Moreover, since said luminescence equipment is a spontaneous light type, since a back light like a liquid crystal display does not fill 1 micrometer with the thickness of an organic compound layer, the formation of thin lightweight is possible [it is unnecessary, and] for it. therefore, the electric appliance with which said luminescence equipment is contained as a display etc. -- the former -- a thin shape -- it becomes a lightweight electric appliance. it is very useful in order to also link this with facilities (the lightness in the case of carrying -- a compact) directly about an electric appliance like especially a pocket device. Furthermore, in an electric appliance at large, that what is been a thin shape (it is not bulky) is useful also seen from a transportation side (mass transportation is possible) and an installation side (tooth-space reservation of the room etc.) does not have misgiving.
[0168] In addition, since said luminescence equipment is a spontaneous light type, it is excellent in the visibility in a bright location compared with a liquid crystal display, and, moreover, has the description that an angle of visibility is large. Therefore, the electric appliance which has said luminescence equipment as a display has a big merit also in respect of the conspicuousness of a display.
[0169] That is, in addition to the advantage of the conventional organic light emitting devices, such as a thin light weight and quantity visibility, the electric appliance using the luminescence equipment of this invention also holds a low power and the features of being long lasting, and is very useful.
[0170] In this example, the electric appliance which contains the luminescence equipment of this invention as a display is illustrated. The example is shown in drawing 15 and drawing 16 . In addition, any of the component indicated by this invention may be used for the organic light emitting device contained in the electric appliance of this example. Moreover, which gestalt of drawing 8 - drawing 14 may be used for the gestalt of the luminescence equipment contained in the electric appliance of this example.
[0171] Drawing 15 (a) is the display which used the organic light emitting device, and contains case 1501a, susceptor 1502a, and display 1503a. By producing the display using the luminescence equipment of this invention as display 1503a, the display which is thinly lightweight, merit-maintains and is carried out is realizable. Therefore, transportation becomes simple, space-saving [at the time of being installation] turns possible up, and a life is also long.
[0172] Drawing 15 (b) is a video camera and contains body 1501b, display 1502b, voice input section 1503b, actuation switch 1504b, dc-battery 1505b, and television section 1506b. By producing the video camera using the luminescence equipment of this invention as display 1502b, there is little power consumption and it can realize a lightweight video camera. Therefore, the consumption of a cell decreases and carrying also becomes simple.
[0173] Drawing 15 (c) is a digital camera and contains body 1501c, display 1502c, eye contacting part 1503c, and actuation switch 1504c. By producing the digital camera using the luminescence equipment of this invention as display 1502c, there is little power consumption and it can realize a lightweight digital camera. Therefore, the consumption of a cell decreases and carrying also becomes simple.
[0174] Drawing 15 (d) is the picture reproducer equipped with the record medium, and contains 1501d [of bodies], 1502d [of record media (CD, LD, or DVD)], and actuation switch 1503d, (Display A) 1504d, and (Display B) 1505d. Display (A) 1504d of image information is mainly displayed, and text is mainly displayed (Display B) 1505d. By producing said picture reproducer using the luminescence equipment of this invention as these (Display A) 1504d or (Display B) 1505d, said picture reproducer which power consumption merit-maintains at few lightweight tops, and carries out is realizable. In addition, CD regenerative apparatus, a game device, etc. are included in the picture reproducer equipped with this record medium.
[0175] Drawing 15 (e) is a pocket mold (mobile) computer, and contains body 1501e, display 1502e, television section 1503e, actuation switch 1504e, and memory slot 1505e. producing the pocket mold computer using the luminescence equipment of this invention as display 1502e -- power consumption -- few -- a thin shape -- a lightweight pocket mold computer is realizable. Therefore, the consumption of a cell decreases and carrying also becomes simple. In addition, this pocket mold computer can record information on the record medium which integrated a flash memory and nonvolatile memory, or can reproduce it.
[0176] Drawing 15 (f) is a personal computer and contains 1501f [of bodies], 1502f [of cases], 1503f [of displays], and keyboard 1504f. producing the personal computer using the luminescence equipment of this invention as 1503f of displays -- power consumption -- few -- a thin shape -- a lightweight personal computer is realizable. When the application with which it walks around like a notebook

computer especially is required, it becomes a big merit in respect of the consumption of a cell, or lightness.
[0177] In addition, the above-mentioned electric appliance displays more often the information distributed through radio, such as electronic communication lines, such as the Internet, and an electric wave, and its opportunity to display especially animation information is increasing. The speed of response of an organic light emitting device is very quick, and suitable for such a movie display.
[0178] Next, drawing 16 (a) is a cellular phone and contains body 1601a, voice output section 1602a, voice input section 1603a, display 1604a, actuation switch 1605a, and antenna 1606a. producing the cellular phone using the luminescence equipment of this invention as display 1604a -- power consumption -- few -- a thin shape -- a lightweight cellular phone is realizable. Therefore, the consumption of a cell decreases, and carrying also turns easy up and it is made on a compact body.
[0179] Drawing 16 (b) is an audio equipment (specifically audio for mount), and includes body 1601b, display 1602b, and the actuation switches 1603b and 1604b. By producing the audio equipment using the luminescence equipment of this invention as display 1602b, there is little power consumption and it can realize a lightweight audio equipment. Moreover, although this example shows the audio for mount as an example, you may use for a home audio.
[0180] In addition, in an electric appliance as shown by drawing 15 - drawing 16 , it is effective to give a function which modulates luminescence brightness according to the brightness of an operating environment by establishing a means to make build in a photosensor further and to detect the brightness of an operating environment. A user can recognize an image or text satisfactory, if the brightness of 100-150 is securable by the contrast ratio compared with the brightness of an operating environment. That is, when an operating environment is bright, the brightness of an image is raised and it is made legible, and when an operating environment is dark, it becomes possible to stop the brightness of an image and to stop power consumption.
[0181] Moreover, since actuation with a low power and the formation of thin lightweight are possible also for various electric appliances using the luminescence equipment of this invention as the light source, they can be referred to as very useful. Typically, implementation of a low power and the formation of thin lightweight are possible for the electric appliance which contains the luminescence equipment of this invention as the light source of the back light or front light of a liquid crystal display, or the light source of a lighting device.
[0182] Therefore, when using as a liquid crystal display all the displays of the electric appliance of drawing 15 - drawing 16 shown in this example, by producing the electric appliance using the luminescence equipment of this invention as the back light or front light of the liquid crystal display, there is little power consumption and a thin and lightweight electric appliance can be attained.
[0183]
[Effect of the Invention] By carrying out this invention, power consumption can obtain the luminescence equipment which excelled [tops / few] also in the life. Furthermore, the electric appliance which merit-maintains at a top with little [it is bright and] power consumption, and is carried out by using such luminescence equipment for the light source or a display can be obtained.

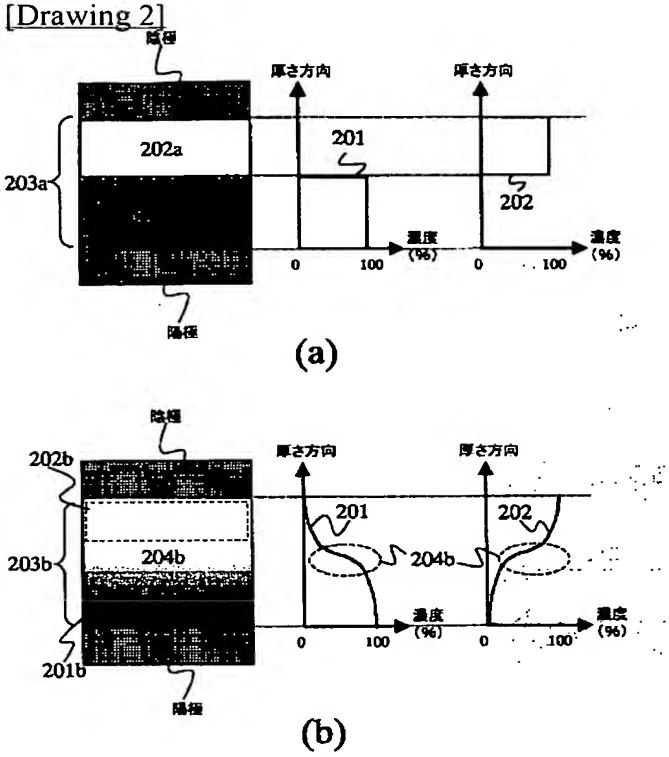
[Translation done.]

* NOTICES *

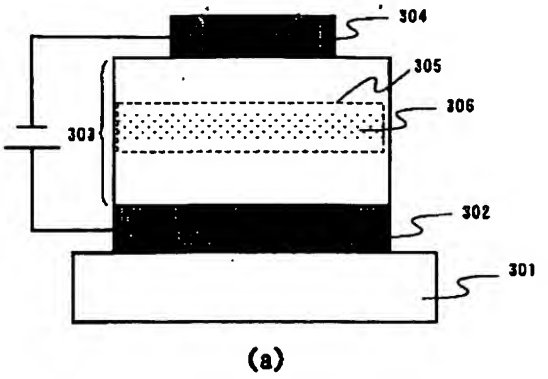
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 2]



[Drawing 3]



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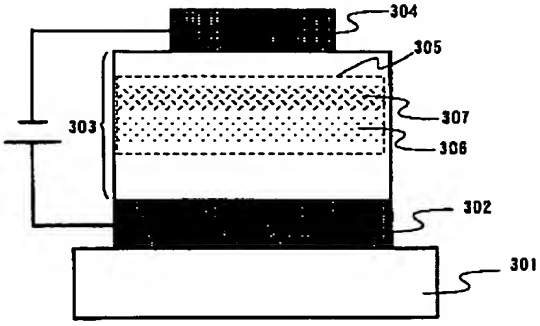
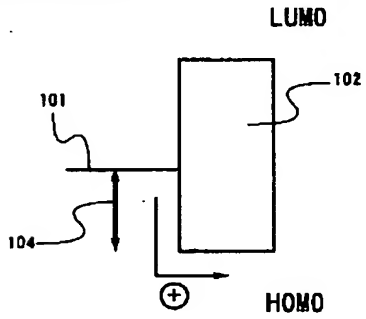


(b)

[Drawing 1]



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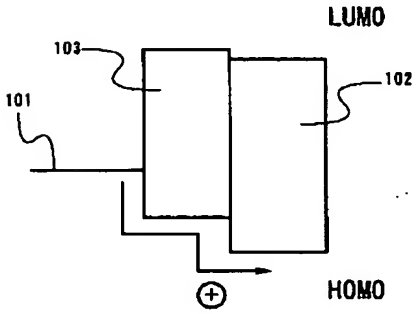
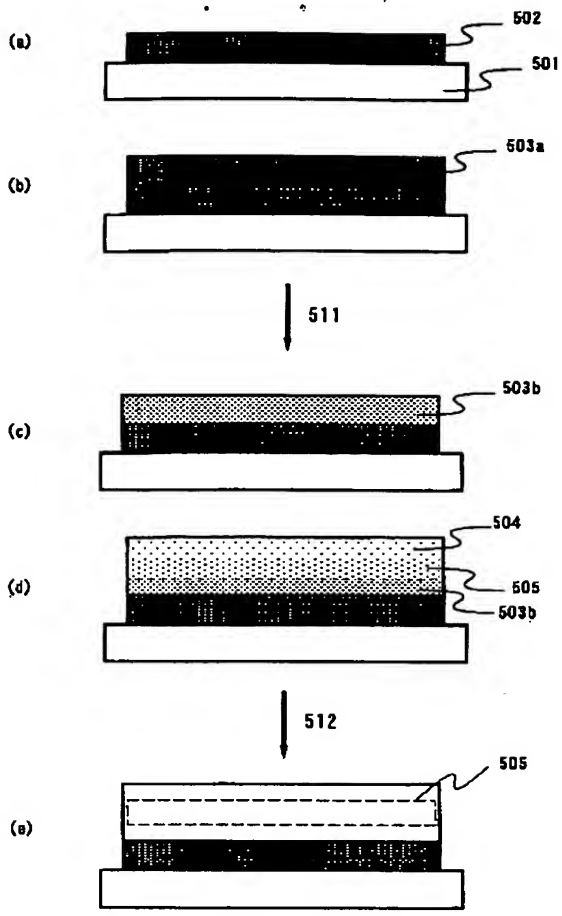
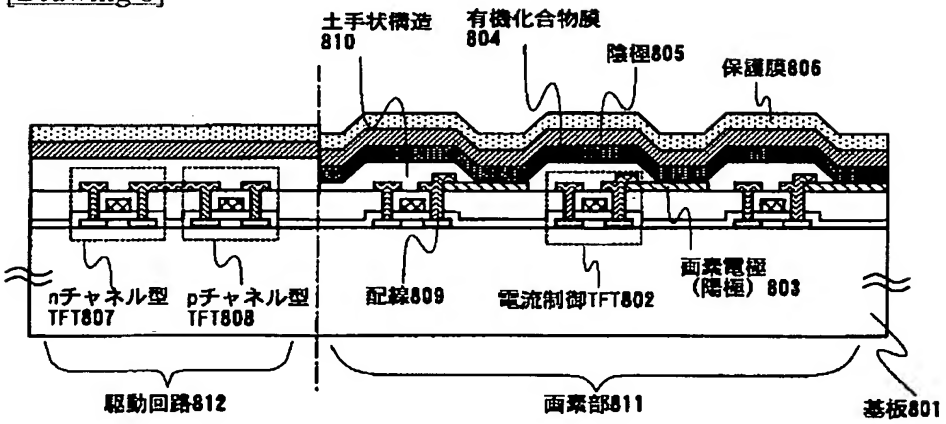


(b)

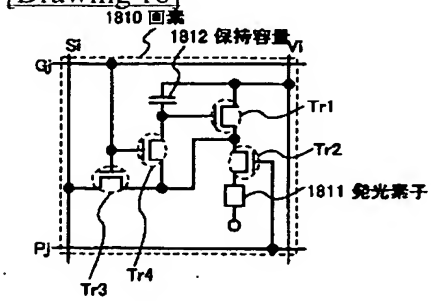
[Drawing 5]



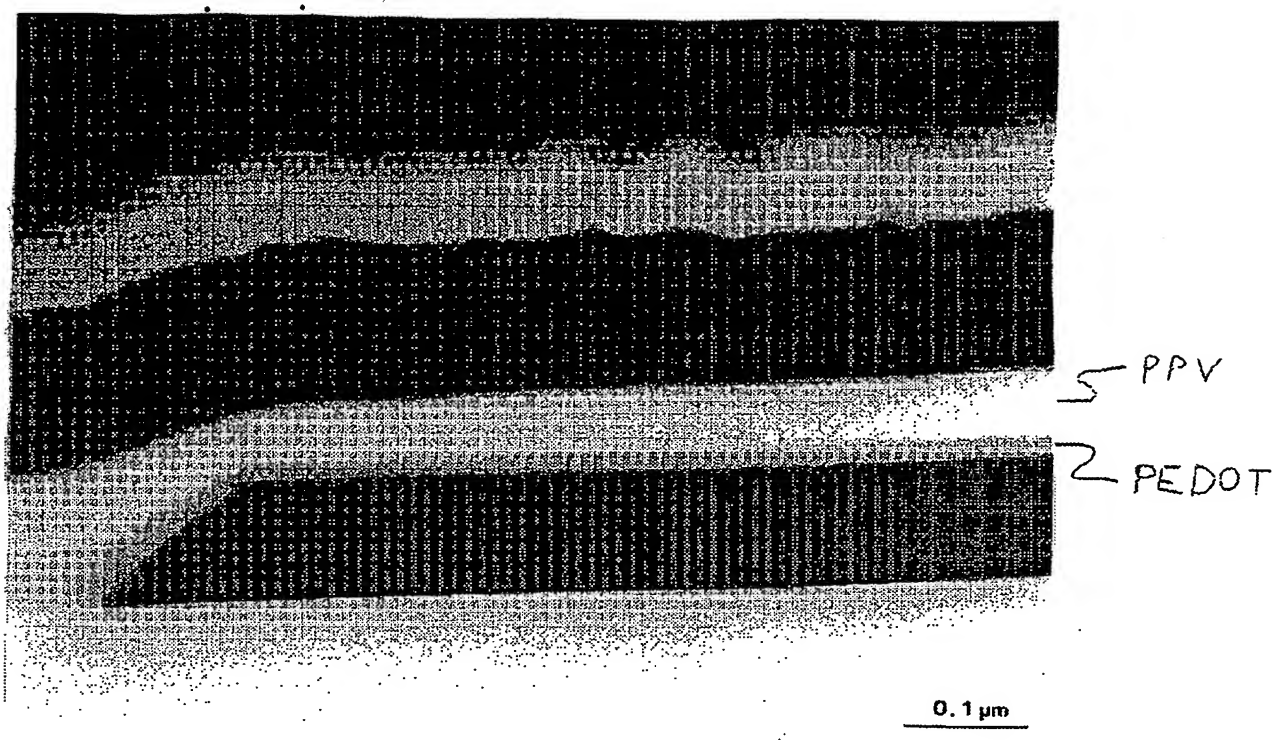
[Drawing 8]



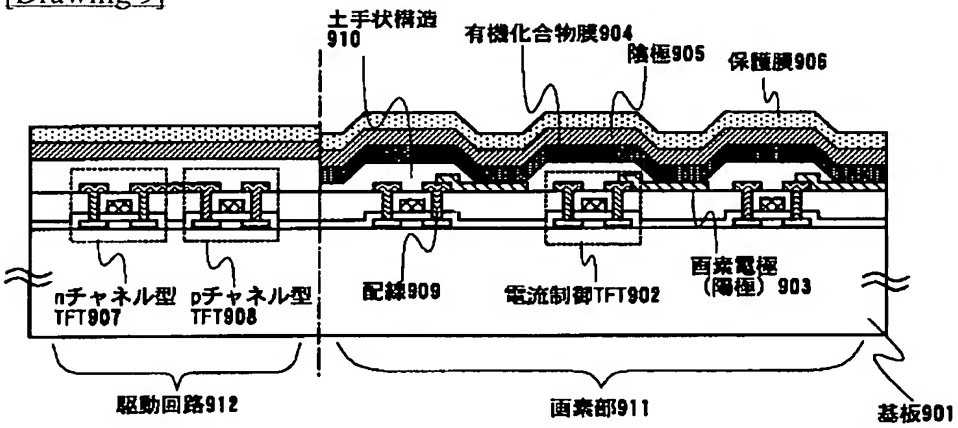
[Drawing 18]



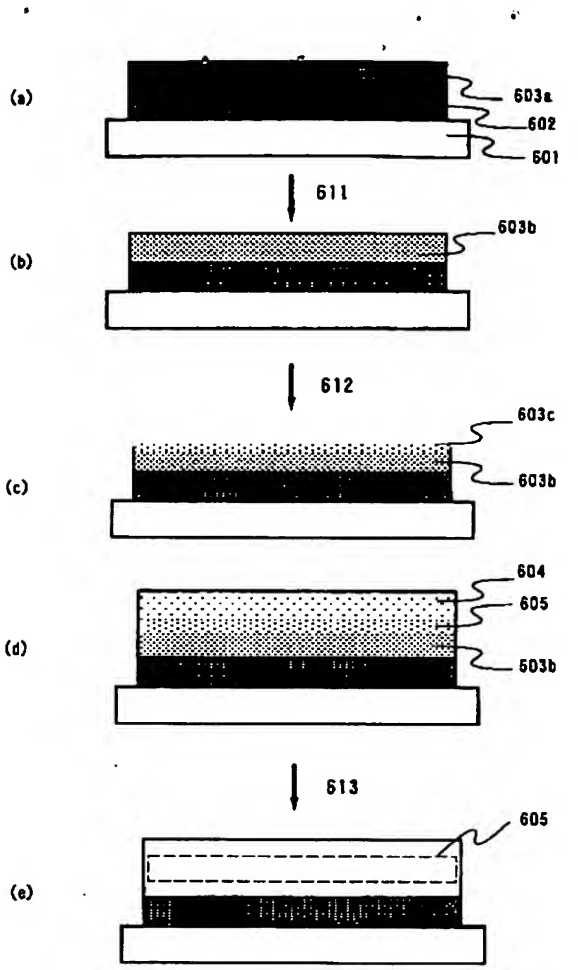
[Drawing 4]



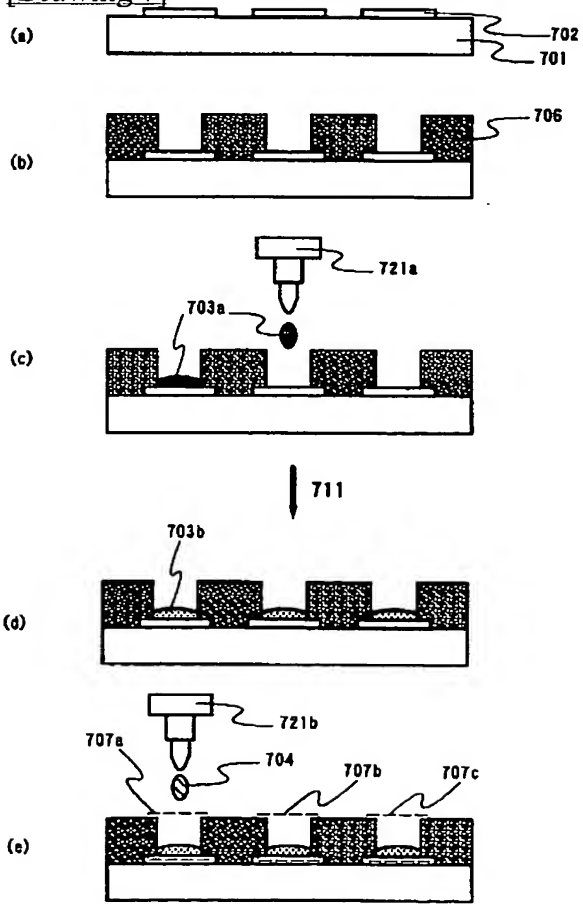
[Drawing 9]



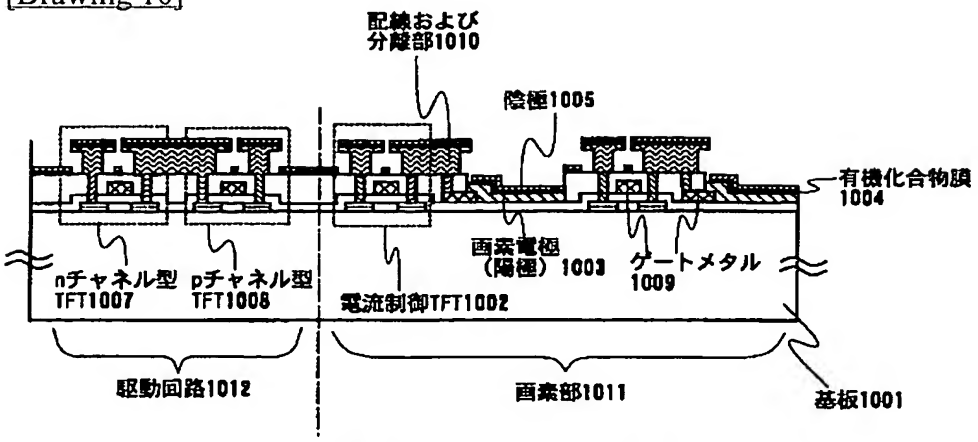
[Drawing 6]


(a)
603a
602
601
611
(b)
603b
612
603c
(c)
603b
604
605
(d)
603b
613
605
(e)

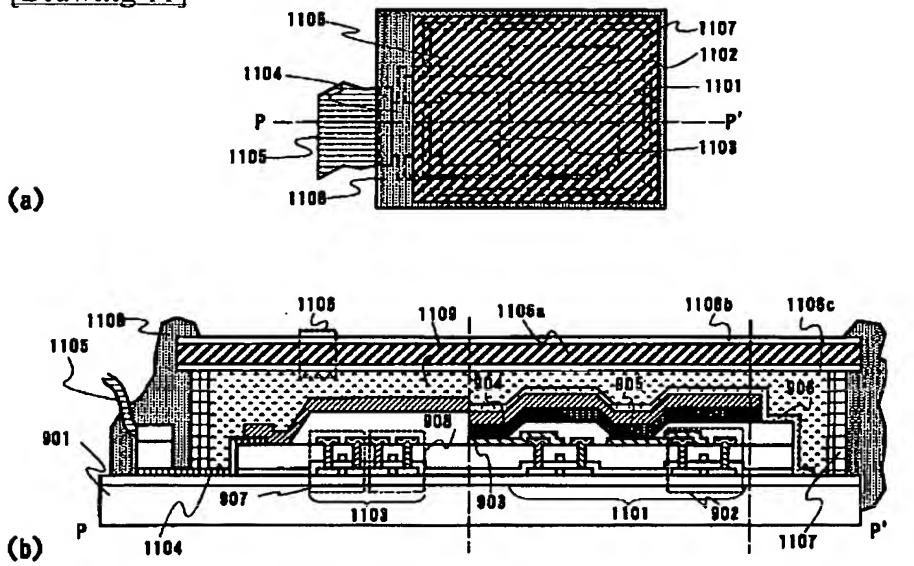
[Drawing 7]


(a)
702
701
706
(b)
721a
703a
(c)
711
703b
(d)
721b
707a
704
707b
707c
(e)

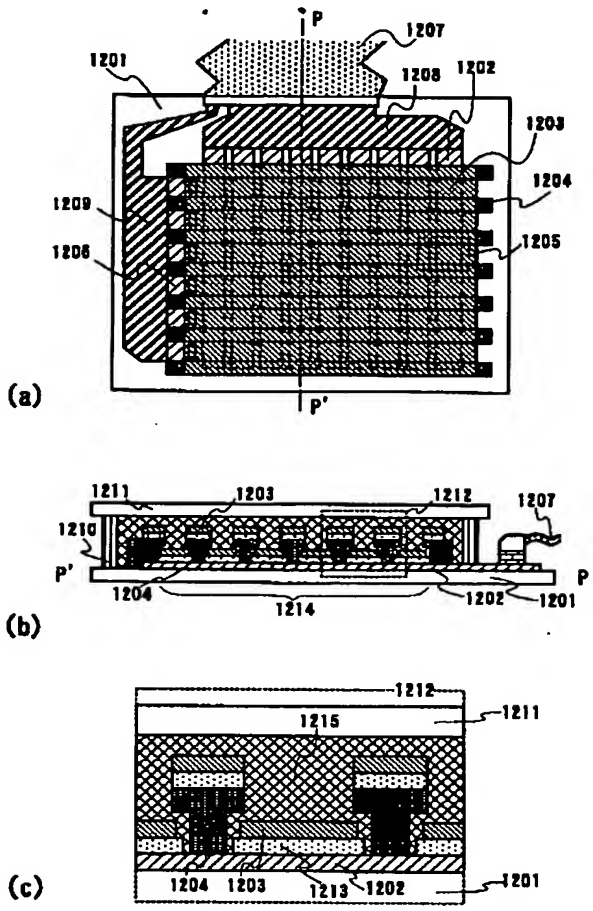
[Drawing 10]



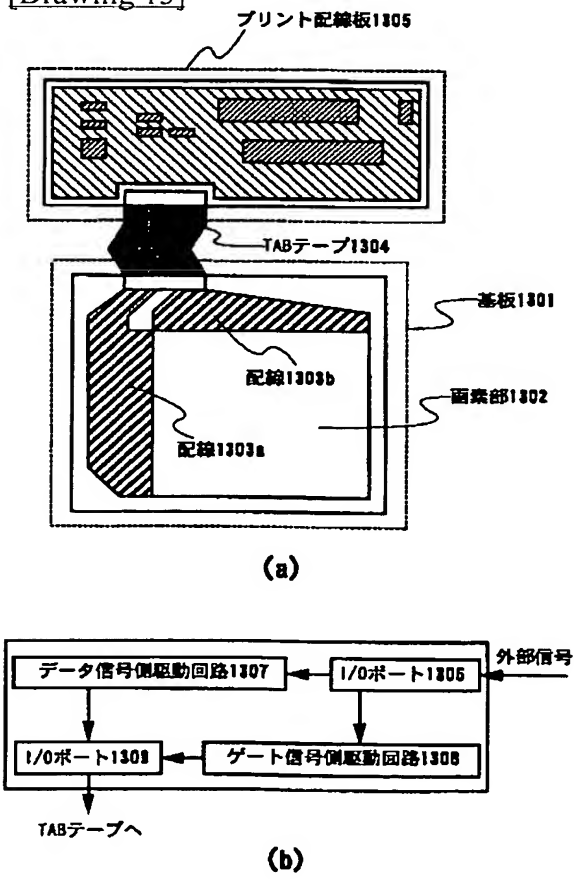
[Drawing 11]



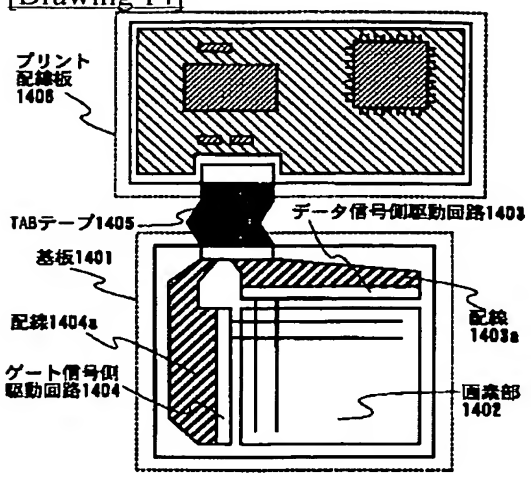
[Drawing 12]


P
1207
1201
1208
1202
1203
1204
1209
1205
1206
P'
(a)
1211
1203
1212
1207
1210
P'
P
1204
1214
1202
1201
(b)
1212
1215
1211
1204
1203
1213
1202
1201
(c)

[Drawing 13]


プリント配線板1305
TABテープ1304
基板1301
配線1303b
画素部1302
配線1303a
(a)
データ信号側駆動回路1307
I/Oポート1305
外部信号
I/Oポート1303
ゲート信号側駆動回路1306
TABテープへ
(b)

[Drawing 14]



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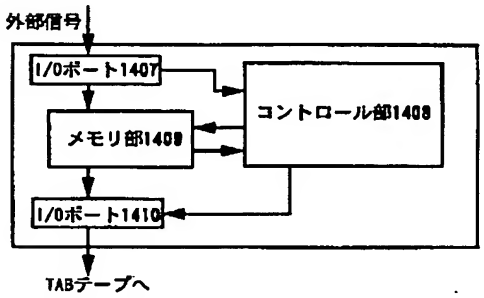
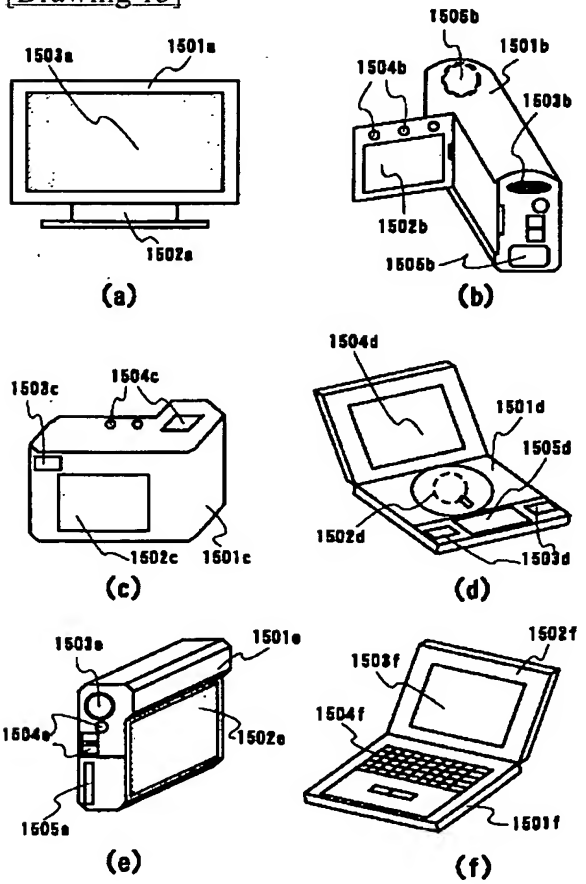
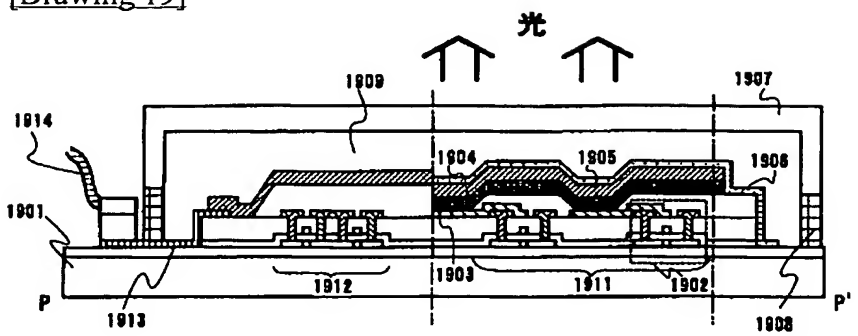


(b)

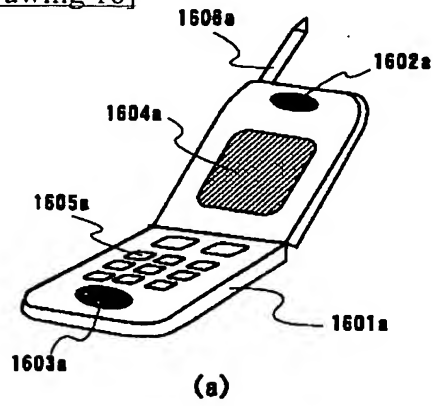
[Drawing 15]



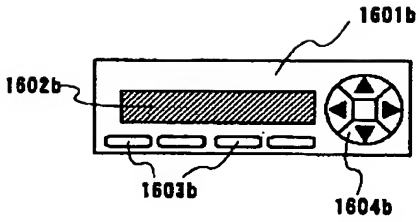
[Drawing 19]



[Drawing 16]

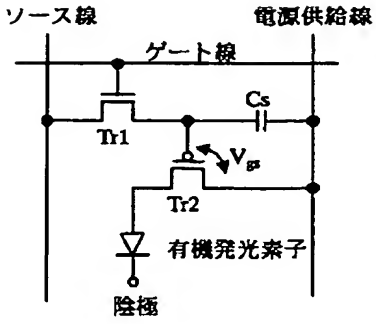


(a)



(b)

[Drawing 17]



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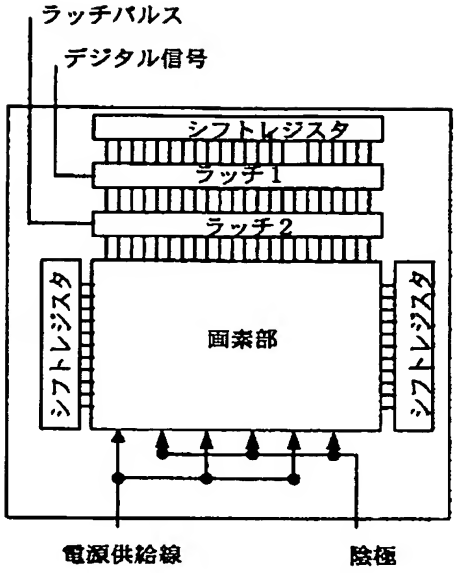

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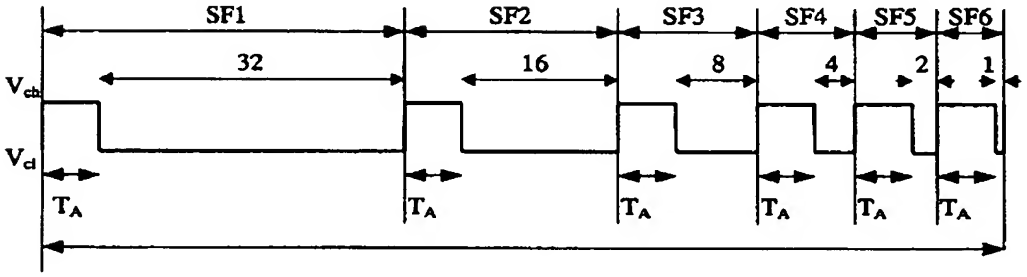

1フレーム

SF1-SF6:サブフレーム, T_A: 書き込み時間

(b)

[Translation done.]

* NOTICES *

CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law
[Section partition] The 1st partition of the 7th section
[Publication date] June 30, Heisei 17 (2005. 6.30)

[Publication No.] JP,2002-289352,A (P2002-289352A)
[Date of Publication] October 4, Heisei 14 (2002. 10.4)
[Application number] Application for patent 2002-9296 (P2002-9296)
[The 7th edition of International Patent Classification]

H05B 33/14
C09K 11/06
G09F 9/00
G09F 9/30
H05B 33/10
H05B 33/22

[FI]

H05B 33/14		B
C09K 11/06	640	
C09K 11/06	650	
C09K 11/06	655	
C09K 11/06	660	
C09K 11/06	680	
G09F 9/00	342	Z
G09F 9/30	365	Z
H05B 33/10		
H05B 33/22		B
H05B 33/22		D
H05B 33/22		Z

[Procedure revision]
[Filing Date] October 8, Heisei 16 (2004. 10.8)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[The contents of amendment]
[Claim(s)]
[Claim 1]
The field which consists of the first compound said compound film of whose is a high molecular compound in the luminescence equipment containing the light emitting device which has the compound film inserted between an anode plate, cathode, and said anode plate and said cathode, and said first compound are luminescence equipment characterized by to have the field which consists of the second compound which is a different high molecular compound, and the mixing zone which said the first compound and said second compound are mixing.

[Claim 2]
It is luminescence equipment characterized by to have the field which consists of the first compound said compound film of whose is a high molecular compound in the luminescence equipment containing the light emitting device which has the compound film inserted between an anode plate, cathode, and said anode plate and said cathode, the field which consist of the second compound which is a low molecular weight compound in which vacuum deposition is possible, and the mixing zone which said the first compound and said second compound are mixing.
[Claim 3]
The field which consists of the first organic compound said organic compound film of whose is a high molecular compound in the luminescence equipment containing the light emitting device which has the organic compound film inserted between an anode plate, cathode, and said anode plate and said cathode, and said first organic compound are luminescence equipment characterized by to have the field which consists of the second organic compound which is a different high molecular compound, and the mixing zone which said the first organic compound and said second organic compound are mixing.
[Claim 4]
It is luminescence equipment characterized by to have the field which consists of the first organic compound said organic compound film of whose is a high molecular compound in the luminescence equipment containing the light emitting device which has the organic compound film inserted between an anode plate, cathode, and said anode plate and said cathode, the field which consists of the second organic compound which is a low molecular weight compound in which vacuum deposition is possible, and the mixing zone which said the first organic compound and said second organic compound are mixing.
[Claim 5]
Said anode plate and said cathode are luminescence equipment characterized by for said first organic compound being a compound of electron hole transportability, and for said second organic compound being a luminescent compound which presents luminescence in luminescence equipment according to claim 3, and said mixing zone having not touched.
[Claim 6]
Said anode plate and said cathode are luminescence equipment characterized by for said first organic compound being a compound of electronic transportability, and for said second organic compound being a luminescent compound which presents luminescence in luminescence equipment according to claim 3, and said mixing zone having not touched.
[Claim 7]
Said anode plate and said cathode are luminescence equipment characterized by for said first organic compound being a compound of electron hole transportability, and for said second organic compound being a luminescent compound which presents luminescence in luminescence equipment according to claim 4, and said mixing zone having not touched.
[Claim 8]
Said anode plate and said cathode are luminescence equipment characterized by for said first organic compound being a compound of electronic transportability, and for said second organic compound being a luminescent compound which presents luminescence in luminescence equipment according to claim 4, and said mixing zone having not touched.
[Claim 9]
Said anode plate and said cathode are luminescence equipment characterized by for said first organic compound being a luminescent compound which presents luminescence in luminescence equipment according to claim 4, and for said second organic compound being a compound of electron hole transportability, and said mixing zone having not touched.
[Claim 10]
Said anode plate and said cathode are luminescence equipment characterized by for said first organic compound being a luminescent compound which presents luminescence in luminescence equipment according to claim 4, and for said second organic compound being a compound of electronic transportability, and said mixing zone having not touched.
[Claim 11]
It is luminescence equipment which is the high molecular compound with which said first organic compound contains a pi electron in luminescence equipment according to claim 5 to 8, and is characterized by performing chemistry doping.

[Claim 12]
It is luminescence equipment characterized by said first organic compound being the poly thiophene derivative, the poly aniline derivative, or a polyvinyl-carbazole derivative in luminescence equipment according to claim 5 or 7.
[Claim 13]
It is luminescence equipment characterized by said second organic compound being a poly para-phenylene vinylene derivative, the poly dialkyl fluorene derivative, a polyvinyl-carbazole derivative, or a polyphenylene derivative in luminescence equipment according to claim 5 or 6.
[Claim 14]
It is luminescence equipment characterized by said first organic compound being a poly para-phenylene vinylene derivative, the poly dialkyl fluorene derivative, a polyvinyl-carbazole derivative, or a polyphenylene derivative in luminescence equipment according to claim 9 or 10.
[Claim 15]
Said first organic compound and said second organic compound are luminescence equipment characterized by containing the third organic compound with which said organic compound film differs in luminescence equipment according to claim 3 to 14, and said third organic compound being added by said mixing zone as a guest.
[Claim 16]
It is luminescence equipment characterized by for said the first organic compound and said second organic compound to be the compound chosen from a group of blocking nature compound ** which can prevent migration of the hole injectional compound which receives an electron hole from said anode plate, the electron injectional compound which receives an electron from said cathode, an electron hole transportability compound, an electronic transportability compound, an electron hole, or an electron in luminescence equipment according to claim 15, and for said third organic compound to be the luminescent compound which presents luminescence.
[Claim 17]
It is luminescence equipment characterized by being the luminescent compound with which said third organic compound presents luminescence from a triplet excitation state in luminescence equipment according to claim 15 or 16.
[Claim 18]
It is luminescence equipment characterized by being the metal complex with which said third organic compound uses platinum as a central metal in luminescence equipment according to claim 17, or the metal complex which uses iridium as a central metal.
[Claim 19]
It is luminescence equipment characterized by said third organic compound having the large energy difference of a highest occupied molecular orbital and a minimum sky molecular orbital in luminescence equipment according to claim 15 compared with said the first organic compound and said second organic compound.
[Claim 20]
It is luminescence equipment characterized by said third organic compound being a phenanthroline derivative, an OKISA diazole derivative, or a triazole derivative in luminescence equipment according to claim 15.
[Claim 21]
The detection field of said metallic element which said third organic compound is a metal complex which has a metallic element in luminescence equipment according to claim 15 or 16, and can be detected by SIMS is luminescence equipment characterized by being said mixing zone.
[Claim 22]
It is luminescence equipment characterized by said metallic element being aluminum, zinc, or beryllium in luminescence equipment according to claim 21.
[Claim 23]
It is luminescence equipment characterized by said metallic element being iridium or platinum in luminescence equipment according to claim 21.
[Claim 24]
The electric appliance characterized by using luminescence equipment according to claim 1 to 23.
[Claim 25]
It is the electric appliance characterized by said electric appliance being a display, a video camera, a

digital camera, picture reproducer, a pocket mold computer, a personal computer, a cellular phone, or an audio equipment in an electric appliance according to claim 24.

[Claim 26]

The manufacture approach of the luminescence equipment containing a light emitting device which carries out wet spreading of the 1st solution which consists of the 1st organic compound and 1st solvent to the substrate which has an electrode, and is characterized by to apply the 2nd solution which heats said 1st solution at the temperature from which the vapor pressure of said 1st solvent becomes below the pressure of an activity ambient atmosphere, and consists of the 2nd organic compound and 2nd solvent after that.

[Claim 27]

The manufacture approach of the luminescence equipment containing a light emitting device characterized by to apply the 2nd solution which subsequently consists of conditions that the solvent contained in said 1st solution is contained in an activity ambient atmosphere after carrying out wet spreading and carrying out stoving of the 1st solution which consists of the 1st organic compound and 1st solvent to the substrate which has an electrode, with the 2nd organic compound and 2nd solvent.

[Claim 28]

Solubility [as opposed to / in case wet spreading of the 2nd solution which consists of the 2nd organic compound and 2nd solvent is carried out after forming the 1st organic compound to the substrate which has an electrode / said 2nd solvent] is the manufacture approach of the luminescence equipment containing a light emitting device characterized by said 2nd organic compound being more expensive than said 1st organic compound.

[Claim 29]

The manufacture approach of the luminescence equipment containing a light emitting device characterized by carrying out wet spreading of the 2nd solution which subsequently consists of conditions that the solvent which can dissolve said 1st organic compound is contained in an activity ambient atmosphere after forming the 1st organic compound to the substrate which has an electrode, with the 2nd organic compound and 2nd solvent.

[Translation done.]